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The Becker Model D-1 Vertical Milling Machine

The great increase in the rates of feed and speed that have been adopted during the last few years has necessitated the production of machines far heavier and sturdier than those produced a few years ago. The vertical-spindle milling machine here described is the most recent product of the Becker Milling Machine Co., and is believed to be the largest, heaviest and most powerful machine of this type on the market. Its size can be imagined when it is realized that pieces of work weighing up to 10 tons can be carried and machined on the work table.

A VERTICAL-spindle milling machine that is believed to be the largest and heaviest that has yet made its appearance on the market is shown in the illustrations. It is the product of the Becker Milling Machine Co., Hyde Park, Mass and incorporates many of the features used in previous designs of this company as well as a number of new and valuable additions. The machine is primarily intended for the machining of large heavy parts and the construction of the knee, saddle and table has been made very rugged. The knee is of great width and is supported by two telescopic screws instead of a single one as in most designs. This feature provides a support for the table that is well out from the center of the machine and takes care of many of the stresses due to overhang when the table is moved to the extreme positions. The position of these two supporting screws and the great width of the knee, 96 in., can be seen in Fig. 1. The knee is also supported by the column or frame of the machine by the use of the Becker patented knee gibbing. A horizontal cross-section of this gibbing is shown in Fig. 2 and it will be noticed that the forward pull on the gib is not carried by the screws holding the gib in place, but by the lock construction of the gib itself. The knee is cast with heavy ribs running in both directions, the spaces between the ribs on the top of the knee being closed in by covers to prevent dirt and chips accumulating. The telescopic screws are connected by gearing to move simultaneously, a method being incorporated to allow their being adjusted independently in order to make any slight adjustments for alignment. The saddle is also 96 in. long and slides on the knee on tapered gibs at the center and a wide flat way at each end. The table is held to the saddle by tapered gibs and has a bearing the full length of the working surface. The table is provided with power rapid traverse in either direction and also a fine hand adjustment, which is available at

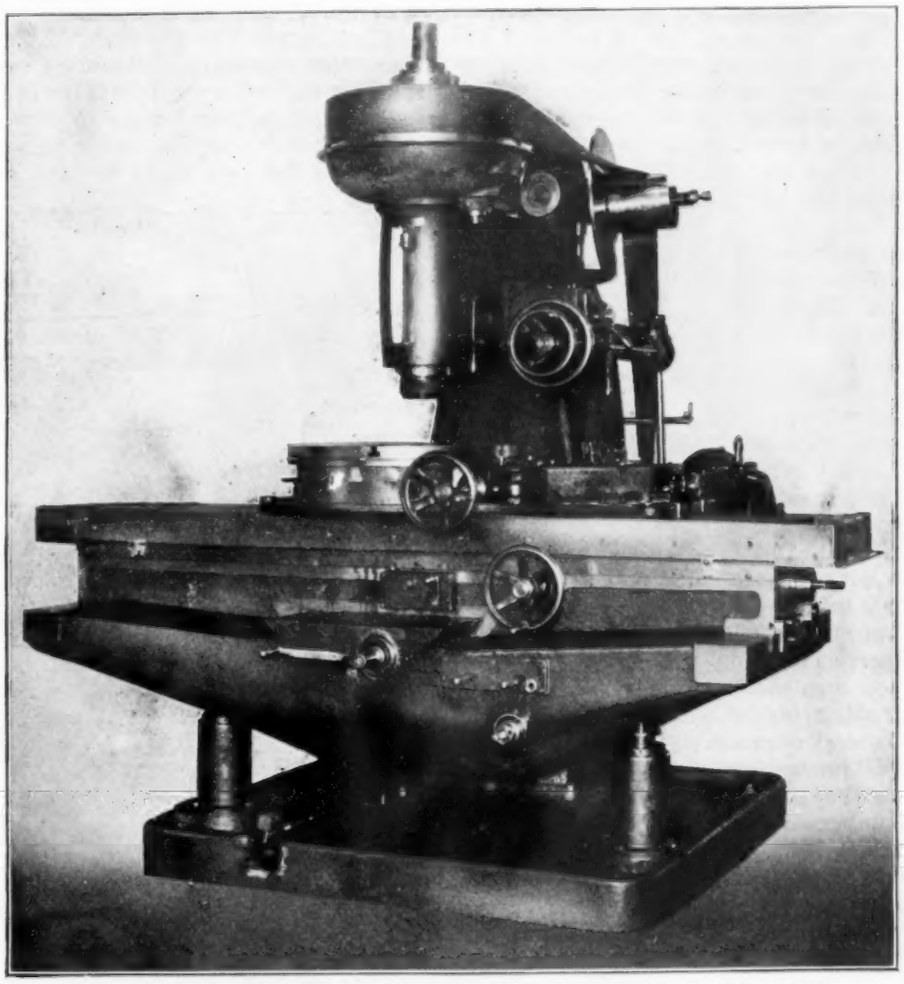


FIG. 1. FRONT VIEW OF THE BECKER MODEL D-1 VERTICAL-SPINDLE MILLING MACHINE

Longitudinal feed of table, 79 in.; cross-feed of table, 20 in.; vertical feed of knee, 20 in.; vertical power feed of spindle, 13 in.; working surface of table, 96 x 20 in.; over-all working surface, 110 x 20 in.; maximum distance between spindle and main table, 22 in.; maximum distance between spindle and rotary table, 13 in.; maximum distance from center of spindle to frame, 25½ in.; T-slots in table, three, ¾ in. wide; length of saddle, 96 in.; length of knee, 96 in.; width of face of column, 24 in.; feeds, from 0.003 to 0.46 in. per spindle revolution, three changes being obtained by gearing and a wide range through friction pulleys; main spindle bearing, 9⅝ in. long, 4 in. in diameter; end of spindle nose, 4½ in. in diameter with No. 14 B. & S. taper hole; speeds, fourteen, 7 with open belt, 45 to 260 r.p.m., and 7 with back gears, 9 to 51 r.p.m.

the front of the knee or at either end of the table. The hand adjustment for cross and vertical feeds is at the center of the knee. A particular feature of the machine is the centralized control, which allows the operator standing at his position at the front of the machine to operate all hand and power feeds. In connection with the centralized control it might be mentioned that in the majority of cases the various movements can be operated from both sides of the machine in order to save the operator the trouble of walking around it. The table has three ⅝-in. T-slots, oil grooves on the sides, and an oil pan at each end for collecting the cutting lubricant from where it is returned to the tank cast in the base of the column.

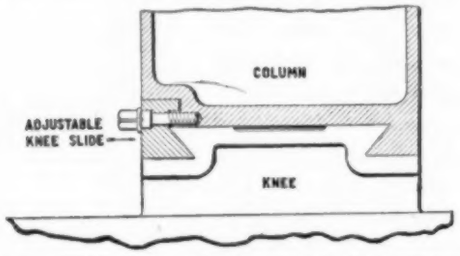


FIG. 2. CROSS-SECTION OF THE KNEE GIBBING

The head can be raised or lowered from either side and the saddle can be moved on the knee from either the rear or front of the machine. Adjustable stops are provided for all of the various movements.

The spindle is back geared and driven by a 6-in., double, quarter-turn belt. The spindle is of the Becker Barrell type of construction and is provided with an adjustable automatic stop, a micrometer stop gage, a fine hand adjustment, and a quick-return mechanism. The construction is shown in Fig. 3. The spindle is carried in a conical sleeve bushed with bronze bearings, means being provided for adjustment to compensate for wear. The end thrust is carried upon ball-thrust bearings supported by the end of the conical sleeve, this construction preventing possible seizure of the spindle due to unequal expansion of the bronze and iron. A micrometer stop is located directly on the front of the spindle, this being very convenient for setting operations. This stop and the slot in the front of the head in which it runs can be seen on the front of the spindle head in Fig. 1.

The back gears are located in the upper part of the head directly under the spindle-drive pulley, and are operated by the small lever projecting from the bottom of the bowl-shaped casting just beneath the spindle pulley.

The feeds with open belt vary from 0.003 to 0.09 in. per spindle revolution, and with back gears from 0.013 to 0.46 in. per spindle revolution. Three changes of feed are obtained by means of the gearing in the feed box that is located at the rear of the machine, while a wide range of feeds between the limits given are obtained by means of the friction-feed device. The two large disks on the idler pulleys at the upper rear corner of the machine are in reality leather-faced friction disks which drive the small friction wheel and the vertical shaft that may be seen at the rear of the machine in Fig. 4, this shaft continuing down into the gear box.

The machine shown is of the single-pulley-drive type, having a gear box giving seven changes of speed; this construction giving 14 speeds in all, those with open belt ranging from 45 to 260 r.p.m., while those with back gears range from 9 to 51 r.p.m. The spindle is provided with a drawbar and draw-in chuck, and is stopped or started by the foot pedal shown at the left in Fig. 1, while a similar foot pedal at the right, which was not in place at the time the photograph for the illustration was taken, controls the rapid traverse. This is driven through a separate belt and pulley at the rear. The moving member for the clutches for engaging the rapid traverse and the speeds is so made that it is impossible for both to be engaged at the same time.

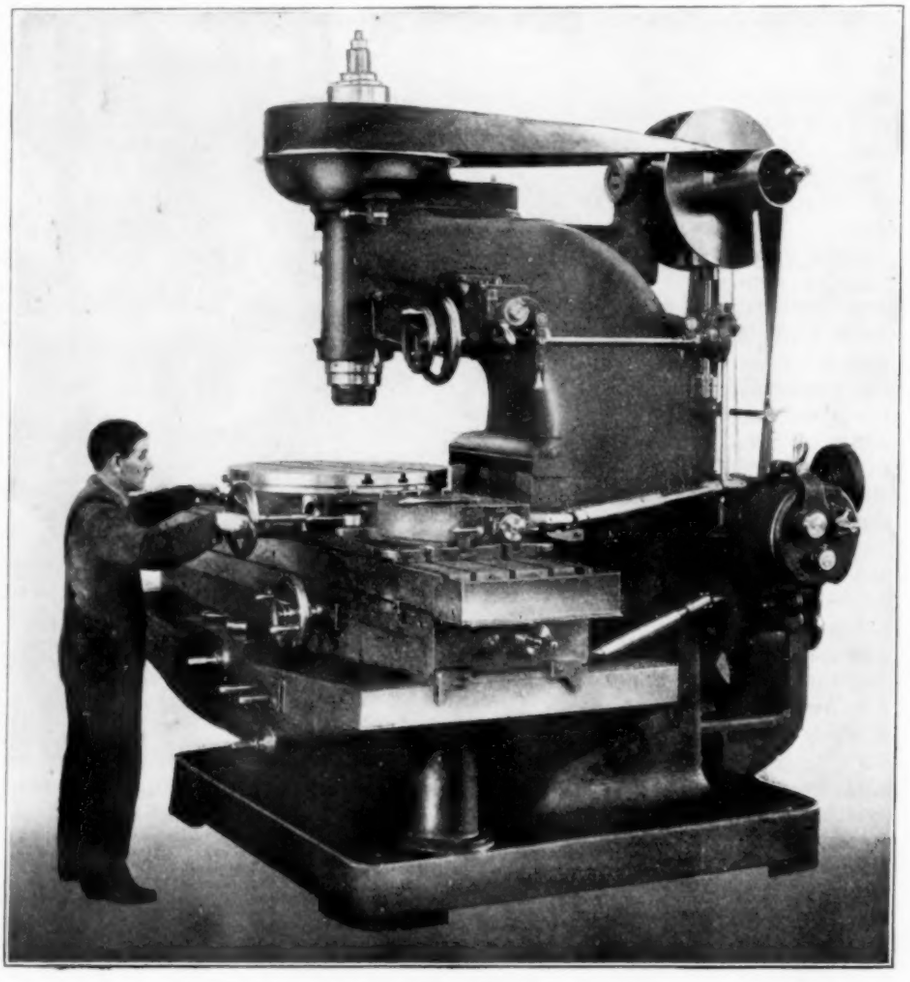


FIG. 4. A SIDE VIEW OF THE MACHINE

Where motor drive is desired, the motor is placed on the extension of the base at the rear right side of the machine. In the case of motor drive, a 10-hp. machine running 850 r.p.m. is recommended, or a motor having a speed range with a ratio of 4 to 1, in which case the speed box is not necessary.

Extras, such as arbor support, oil pump with con-

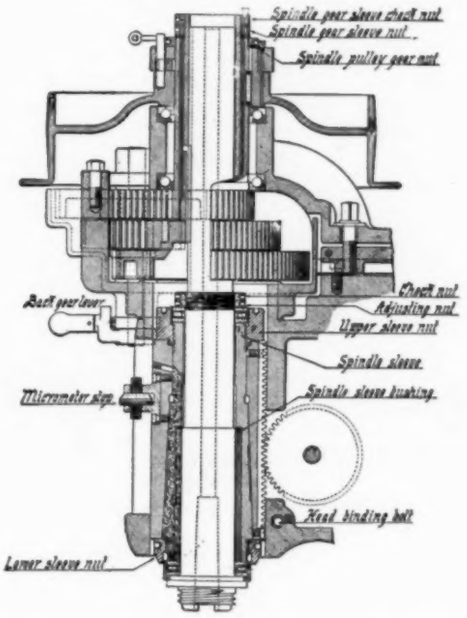


FIG. 3. CONSTRUCTION OF THE SPINDLE AND HEAD

nections, and a rotary table with a circular top graduated to 360 deg. and having a working surface 30 in. in diameter, can be furnished. Both Figs. 1 and 4 show this rotary table in place.

Red Pans to Speed Up Hoodoo Jobs

BY PETER F. O'SHEA

The workmen at the special tap plant of the Greenfield Tap and Die Corporation do not especially admire orders assigned to them which call for only one or two or three duplicate taps. Such orders are to them a nuisance. Even though a very good piece rate is put on such work a man can make more by doing some order calling for 500 to 1000 taps, because the time of setting up his machine more than eats up the extra profit. Therefore each workman had until recently avoided a pan containing only one or two blanks in process. If he had to take the pan he found every possible opportunity to let it lie under his bench or out of sight while he went on with some large order in which there was money.

If only a man here or there postponed a job in this way it would not amount to a great deal. But when at the recent January inventory all the stray small jobs were collected together they made a striking exhibition. There were a total of 300 of them which had been squeezed aside by the pressure of war work. As it was time for New Year's resolutions the manager made one for the whole plant, and like a wise man provided mechanical means for getting action on the resolution.

The work in process in this shop is kept in small pans of uniform size. This is a special plant, something like a job shop, because it confines itself to special taps. These include left-hand and metric threads, odd pitches and unusual diameters, leaving the mass of the regular sizes to another plant of the corporation. One pan therefore may hold either an installment of a fairly large order of 500 or 1000 or it may have only one tap rattling around in it as the complete order. The number of pans in the factory may be judged by the fact that the inventory revealed 300 of the delayed pans containing orders for from one to six taps each.

PANS ARE USED FOR SMALL ORDERS

So the works manager took two hundred of the pans and had them painted with red enamel so brilliant that they could be seen a mile off. These pans are now being used for all small orders unless they are jobs for which there is no hurry. Such a pan cannot remain hidden under a bench for it almost throws a bright light around the corner. And when a man goes to the job bench along the aisle to get his next work the red pans (marked *A* and *B* in the illustration) stand out, so that by no human ingenuity in absent-mindedness can he possibly

THE PANS MARKED A AND B ARE PAINTED RED TO MAKE THEM STAND OUT FROM THE OTHERS

succeed in not noticing them. If he turns away from the bench leaving a red pan behind him he immediately hears about it from the other workmen, who can be depended upon to look after their own interests.

To accompany the red pans the works manager established a regular schedule for putting a small hurry-up order through the shop as follows:

	Hours
One tap $\frac{1}{16}$ in. to 1 in. from blank	20
Two to three taps $\frac{1}{16}$ in. to 1 in. from blank	30
Four to six taps $\frac{1}{16}$ in. to 1 in. from blank	40
One tap 1 $\frac{1}{16}$ in. to 2$\frac{1}{2}$ in. from blank	30
Two to three taps 1 $\frac{1}{16}$ in. to 2$\frac{1}{2}$ in. from blank	40
Four to six taps 1 $\frac{1}{16}$ in to 2$\frac{1}{2}$ in. from blank	50

From steel add 10 hours.

Combination pipe taps and drills, square or Acme thread taps, double time.

DOES NOT INCLUDE SHELL TAPS

The schedule should be interpreted as follows: Making one single tap takes nearly as much time as making six duplicates on account of having to adjust machines. This circumstance is allowed for in the schedule. If the

taps are of special pitch, but can be made from blanks of a regular diameter previously turned and square-ended, manufacture of the order starts in at once from stock blanks. If the blanks in turn have to be specially made from the raw stock of a steel bar 10 hours is added. The number of hours at the right represents the complete elapsed time from the receipt of the order to the shipping-room door. This schedule is posted throughout the shop. The order ticket in the pan bears the date of receipt and the day and hour that it has to be finished so that everybody may know whether he is up to schedule on the job.

This schedule is not an ideal to be aimed at, but a practical working time which is being operated on and which contrasts very much with the former elapsed time of these jobs.

The red pans immediately speeded up the small jobs. Before the week was out all those that had been roaming around the shop for a long time previous to the inventory were cleaned up and out of the way. Now the only small orders that are still in the shop are those received within two or three days.

The Schedule Proved Practical

The schedule proved so practical that it is now maintained as the regular schedule for all small orders that are wanted at once by the customer. Small orders have to be done and they can be done just as quickly at once as later on.

Speed in the carrying through of small orders is especially important. If a man sends in an order for one special tap the likelihood is that he needs that particular tap very much and that his shop cannot go ahead on some job without it. If a man sends in an order for 500 taps he is only providing ahead and certainly does not need the 500 right away. These can therefore be made up on a semi-manufacturing schedule instead of as single pieces. Then too the customer when he is in such a rush wants to know definitely how long it will take him to get the work done and the taps delivered.

Night Life in a Shipyard During the War

By Clarence F. Getzlaffe

I have just finished a year's experience in one of the shipyards and wish to tell the readers of *American Machinist* some of the things that came under my observation during that period. I was on the night shift and all newcomers came under the critical eye of our gang, and they surely got their sizing up just as I did when I first blew in with my trusty tool box.

One night a young fellow came along who knew all the ins and outs about a lathe, so he was given some 3½-in. pipe flanges to bore, thread and face. To his sorrow he soon found that watching some one run a lathe and running one himself really ought to be listed under separate headings. After spending two hours in truing up the first flange, looking at it from every angle even to sighting it over the tailstock, it passed his inspection. However, he evidently thought someone ought to O.K. it, so he asked one of the helpers what he thought of it, but that flippy helper had no sympathy and said, "I don't know, I ain't running the durned thing." A few minutes later the big chief happened along and said, "What are you doing?"

"Just getting started," was the calm reply. This did not suit the boss as far as speed was concerned and he told our friend he would not do. After the *master mechanic* had given the boss's verdict the once over, our friend said:

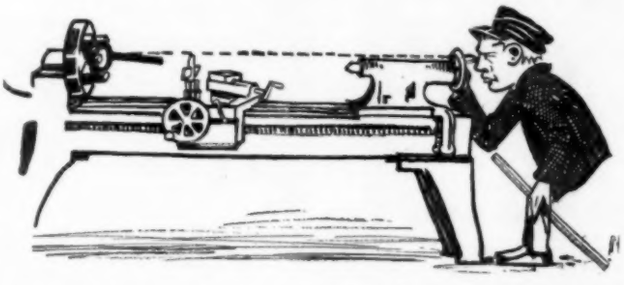
"Have you got a shaper, Boss?"

"Yes," said the boss, "can you run one?"

"Sure," said our friend, "one that goes like this," moving his arm violently backward and forward. This last demonstration made the boss smile but failed to pull down the job.

Then our friend tried to get a job running a hack-saw but the boss told him the helpers ran them, so he packed up his tools and left, thinking we were the meanest bunch on earth.

Next came another lathe hand, inexperienced, but possessing a lot of confidence. He was given the task of making an eye-bolt with a threaded shank about 6 in. long. Whenever I did a job like this in the lathe, I usually ran the threaded end of it on the tail center, but this fellow did not like that way so he gripped it by the eye in an independent chuck. I have seen many threads



and have cut not a few myself, but his was the queerest standard I ever saw—no special name for it. I'd hate like the deuce to make a nut to fit it. I think the angle of thread might be expressed as 60 deg. latitude, longitude unknown. Well, anyhow, this fellow lost his job in two hours.

Regular Guy on a Boring Mill

The next fellow was different from the rest, a type all by himself—regular guy on a boring mill, so he claimed. He hailed from Michigan. The first thing he did was to ask the boys for an "inside hub tool." We usually use a boring tool when boring a hole but this fellow had names of his own. When he saw that he was falling down on the job he said "I don't know much about this *dry cutting*, but if you fellows will help me along a bit I'll get by." Since we were not hired as instructors and he did not hire out as an apprentice, he did not get much comfort from us. As there is a law in this state prohibiting a foreman from discharging a man after midnight, he lasted until morning.

The next fellow was a sad case. He hailed from Washington, had already served in the capacity of master mechanic and took first prize at stammering. The first job turned out to be a bull, but he was not to blame for the toolroom jack gave him the wrong size drill. When he sprung this story on the boss, he was asked if he would use a pipe wrench for a sledge just because the toolroom jack made a mistake. The second night the poor fellow stripped a gear. If the boss jumped an inch when he saw that I'll bet he jumped a yard.

"Say, fella," says he, "I've got a notion to fire ya."

"You can't d-d-do it," was the answer, "I-I-I'm g-g-going t-t-to q-q-quit."

"Well you might as well," says the boss, "for I would have fired you anyway."

MAKING A JOB *of* TRAINING LABOR

By

Harry H. Tukey

If a carpenter can be made into a lathe hand in a few weeks why not try the system that did it on your apprentices? Aren't the times ripe for the introduction of labor-training methods that will cut down the training period, produce better workmen and boost the credit balance?

I WONDER, Mr. Manufacturer, if we might take a few minutes to recall the old days when you ran your plant so differently from the way you do now?

Do you recall how the forgings came in from the smith shop, were roughed off on the planing machine, then carried up the shop to the lathes, across to the hydraulic press for force fitting, back to the planing machine for a finishing cut and up the shop again to the erecting floor? Don't you remember the confusion that resulted. Nobody in those days ever thought much about locating machines according to sequence of operations, nor about analysis of the job into operations, nor of standards or costs (except roughly) or any of the schemes that developed later. Of course you lost a lot of money in idle time of men and machinery now that you see it that way, but it didn't make much difference then because competition was not so keen and the margin of profit was greater.

Yes, those were the happy days, but they're gone. The advance of the age has changed matters. The production engineer came along and pointed out the error. You laughed at him at first and called him an "efficiency guy." But competition also came along and cut down your margin of profit and you had to sit up and take notice.

Then it became clear that the expense of changing those machines to facilitate handling the work was necessary and would save you money. It became apparent also that it was worth while to hire someone to determine just what operations composed this or that job and to see that they were followed in that order. Your shops took on a semblance of organization. You knew what you were doing with your raw material and could place your finger on the leaks and stop them. You began to know something accurate about your costs and you could meet competition successfully, regardless of the decreased margin. You learned that organized control of machine output was vitally necessary to the economical operation of your shops. You made a job of finding out just what went into the producing of your product to make it salable to someone else at a profit to you that would keep your head above water. You standardized the machine, the shop, the output and to some extent the workman's operations.

I suppose you are about ready to ask what all this has to do with training labor. Just this: While you have been advancing in the above you have neglected the human side of the equation. You have continued to employ the same methods in the development of new or existing labor in your shops that you were employing when competition was not so keen. It is the one leak that you have not yet stopped, and it is a big one.

You have employed your new men as helpers, placed them with mechanics and, figuratively speaking, have let them wander through their work having "operations" performed upon them (experiences) much as the forging used to "wander" through the shop. As the progress of the forging was governed by the machine which happened to be open for it, so the progress of this learner is governed, under the present condition, by the kind of a job the mechanic happens to get.

Further, let me call to your attention the fact that you have placed this helper with a mechanic employed to do a mechanic's job and not a teacher's. You are buying the mechanic's services because he has mechanical ability to be put into your product and not because of his teaching ability. Every minute of his time you utilize for teaching purposes deprives your product of just so much productive time. Every time you make a mechanic responsible incidentally for the training of your labor you commit highway robbery on yourself, both coming and going.

Although it can't be seen, there is a tremendous overhead when eight or ten foremen or mechanics give a portion of their productive or supervisory time to the training of eight or ten green men, and they are probably doing little real teaching at that. In fact we have had to unlearn many mechanics made in this way

within the past few years. We have found that some of their teachers had taught them expensive methods of operation. That again was beyond our control because we had too many teachers with no one responsible for the teaching.

We have taken it for granted that it takes a certain time to make a mechanic, and let it go at that. The peculiar part of it is that very few of us have made mechanics; most of them have made themselves. They have been their own best teachers and have learned by their own initiative and effort rather than by any effort on our part to teach them.

Again in the case of our apprentice systems the same general practice obtains. We indenture an apprentice for four years or more, place him in the shop, forget about him and at the end of the required time release him and call him a mechanic. Sometimes we don't call him that, but he does and gets away with it. The only evidence, however, is four years' time.

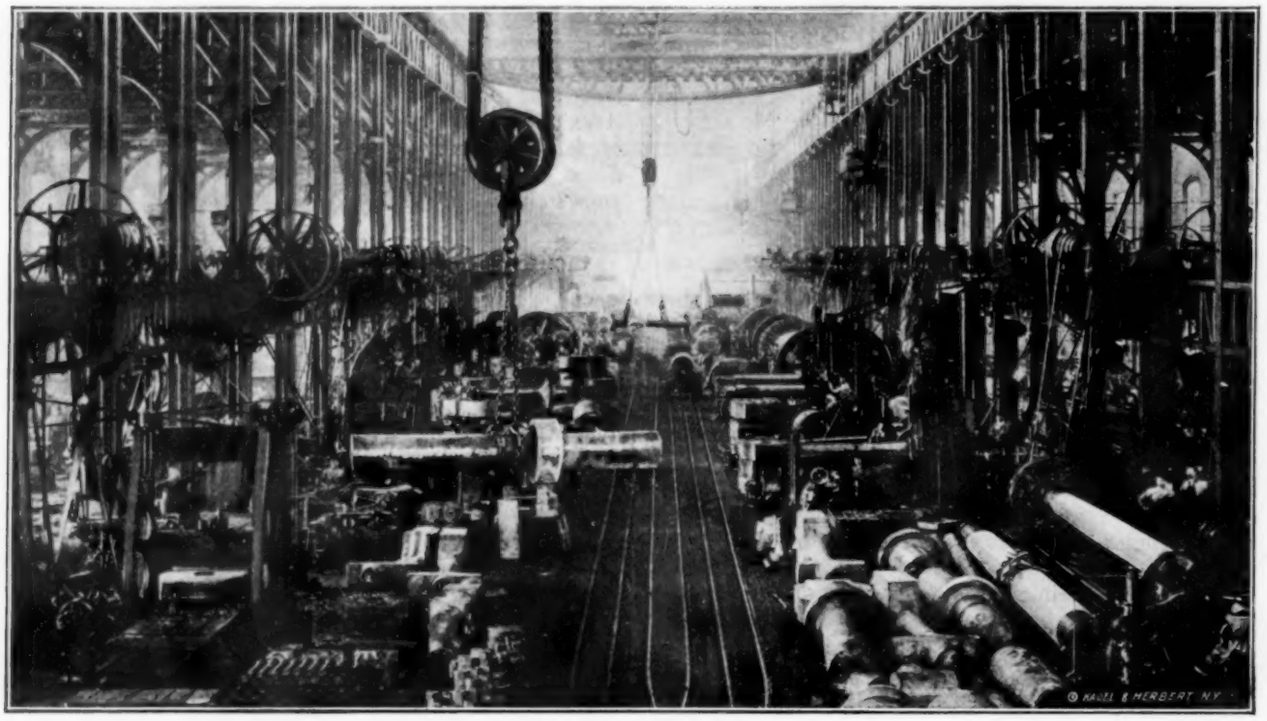
Let's see what happens in that time. First six months—runs errands and sweeps shop. Second six months—odd jobs, some too difficult, requiring a long time to learn or resulting in spoiled work and discouragement; others too easy, leaving time for monkey-shining. Second year—boy improving, able to do a few jobs well enough so that we keep him on those jobs and make a little money on him. All he learned could have been taught in three months and the rest of the time exploited. Third year—same procedure. Fourth year—same thing generally, but not quite so bad. Result—trade half learned.

Unquestionably, all that has been learned could have been taught in two years' time, at the end of which we would have known the product quantitatively and qualitatively. Under the existing method no one person has been responsible for the manipulative knowledge the boy may have obtained. In some plants classroom instruction of a technical nature is given, but nothing more.

Why not determine what a mechanic ought to know to be competent in a given trade, lay it down in black and white in terms of jobs, put the apprentice through them, whether it takes two years or 10, and hold him until he can do them? Cut out the exploitation and get the full mechanical value of your man in the shortest possible time. Give the apprentices real jobs graded to their ability. Train them to use not only their heads but their hands as well. Place them under the supervision of a competent instructor who will be responsible for them, and they will pay the instructor's salary and give you a profit besides.

Many large industries have maintained apprentice schools and other educational endeavors with a view to obtaining greater efficiency. In my opinion most of these schools are only classrooms where apprentices and others may become mathematicians or scientists, and while much of the work has been a valuable aid to the worker a large portion of the instruction did not directly relate to the learner's daily work but was simply of general educational value. It would seem better for the employer to train the employee to use skillfully the kind of technical information that his job demands than spend time and money teaching him algebra when he required only simple arithmetic in his daily calculations. This information can best be given on the job at the time of immediate need when it can be visualized and its practical value shown.

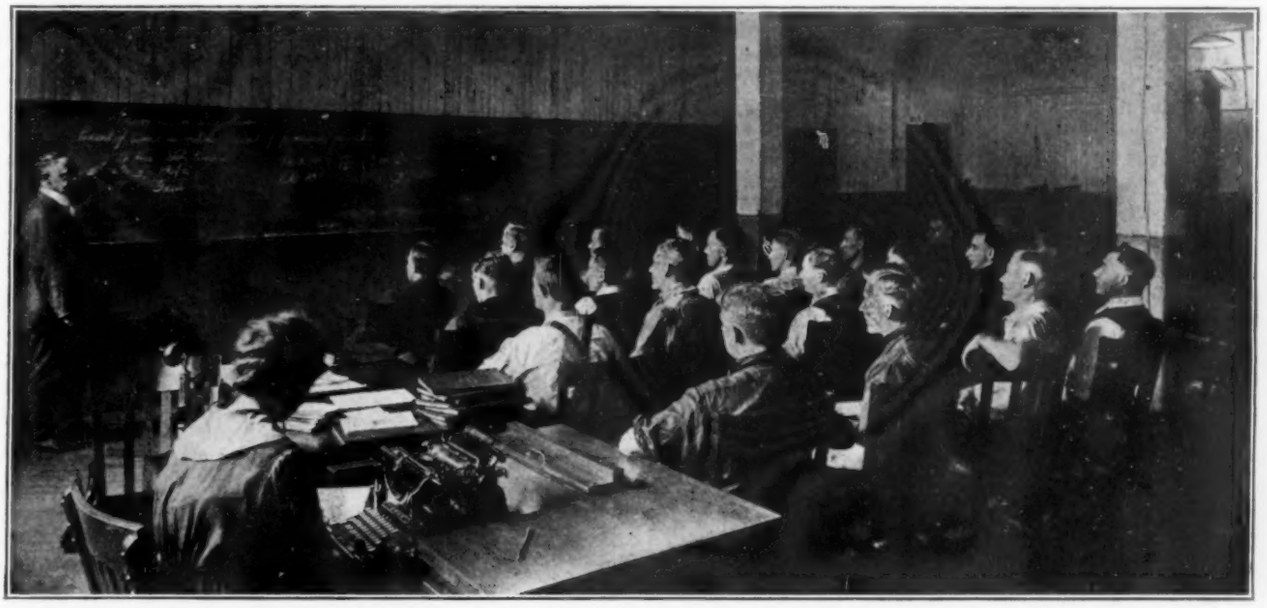
The man you want, Mr. Manufacturer, is the man who can do a good job and whose related trade knowledge is sufficient unto the accomplishment thereof. You want the man who has been trained to think his way through a job, not the one who does simply what someone told him was right without any knowledge of why it was done that way. The only way you



A MODERN MACHINE SHOP

can get such a man is to put someone on the job who can train men to think their way through simpler jobs and turn them over to you as thinking workmen and not automatons or mathematical prodigies. The only reason such men are scarce now is that we have not gone about the job properly. Isn't it high time to begin?

The solution of the problem will unquestionably be found in the installation of an organized training department composed of instructors who are good mechanics and who have been trained to impart their knowledge. These instructors should be placed under a department head who is thoroughly competent both as teacher and mechanic and is an executive as well. By such a plan you will be making a job of training labor just as you have made a job of employing labor, and it should be obvious that the suggested job is just as big and important as any phase of the work of your organization.



THE CLASSROOM METHOD OF LABOR TRAINING

We have tried welfare schemes and countless other philanthropies calculated to create interest on the part of workmen, improve their workmanship and raise their social level, but let me repeat the recent statement of a prominent manufacturer and employer of some 14,000 men: "There is no one industrial activity that will do as much toward increasing and improving the national output and at the same time raise the social level of the working classes as industrial training within the plant."

A proper training plan would first call for an analysis of the line of work or trade for which the learner was to be trained. This analysis would be entirely in terms of learning difficulties and would lead up to the formation of an "operation" sheet, which as applied to the learner is entirely similar in its function to the ordinary operation sheet used in the shop. It provides a schedule of learning experiences in terms of representative shop jobs, through which the learner should pass in order to attain the required ability. As shop jobs are completed experience is gained. When such jobs are laid out in order of difficulty and are given to the learner in this order a close check on progress and ability can be obtained. When the analysis is made and the list of jobs made out no great amount of study is necessary to include with each job the technical information called for by that job. This will facilitate the teaching of the required technical knowledge at the time it will be best understood and appreciated and requires very little if any classroom instruction.

The trained instructor will be able to make the analysis and layouts previously mentioned and adhere to them. He will instruct a number of learners all the time on productive work as against the old plan of one learner (helper) to one instructor (mechanic) with only a portion of the time either instructive or productive. He will develop all there is in the learner and at less cost and will reduce your labor turnover. He will know how to create interest on the part of the learners as a result of his training.

I have had both trained and untrained instructors under my supervision and can testify to the value of the trained instructor in terms of the quality of the mechanic he produces and in terms of decreased training time.

I suppose that by this time the prevailing thought in your mind, Mr. Manufacturer, is the cost of this training of labor. First let me call one or two points to your attention:

It makes no difference whether you follow out the above suggestions or not, if you are hiring labor, skilled or unskilled, and are eventually getting this labor to a state of proficiency that conforms to your standards, you are paying a bill. When this training is carried on in an organized manner you are in a position to know the size of the bill. If you have the mechanic-helper plan you cannot tell what the bill amounts to. Do you prefer to know and control the cost, or do you prefer to play ostrich?

I will point out the general factors involved in the cost of operation of a training department, and from this you may work out your own cost approximately. One instructor can handle from six to twelve men, depending on the trade and conditions. Contrast this

with either of the existing methods, compute the difference and credit it to the cost of organized training.

The production value of the work of these learners should at least offset their wages, and their increased productivity as against their productivity as helpers should credit toward the cost of organized training.

If you still have a charge against organized training subtract therefrom the time lost in story-telling, etc., by the mechanic-instructor and his helper and also the amount it costs you to obtain a skilled worker and you will have your cost. What is it—credit or debit? Account is not taken of the psychological effect of a training department on the rest of the workers nor of the value of a known cost. These values cannot be measured in dollars and cents.

The Advantages Summarized

Summarized the advantages to be gained by making a job of training labor are as follows: (1) Increased efficiency of the trained product; (2) utilization of the entire time of foremen and mechanics in the performance of their proper function; (3) knowledge and control of instruction given; (4) technical instruction functioning with the job; (5) stabilization of labor and reduced turnover; (6) knowledge and control of training costs, and (7) increased productivity of learners.

In the international competition that must necessarily occur in the coming reconstruction period this country must suffer certain disadvantages in high labor and material costs. As this is true even now in many lines it follows that in order to compete successfully we must improve our production both in quantity and quality. This can only be done by training those who produce to become better producers and by improving machinery. Machinery is continually being improved, and therefore it seems that we should now concentrate as strongly in improving the worker to the mutual advantage of all concerned.

What Was the Matter With Jones?

By Harry Senior

"See here boss," said Jones, foreman of the assembling department to his superintendent, "Whatinell am I going to do about this?"

"What's the trouble George?" inquired the superintendent.

"Why, this here lotta pumps that's going through now will be a disgrace to the firm unless something is done. The lathe work is bum. Some of the parts are too short and some are too small in diameter; not very much to be sure; not so much that they can't be assembled, but enough to make a bum job of the whole bunch."

"Does the foreman of the lathe department know of this trouble?" asked the boss.

"Unless he's deaf," retorted Jones. "I've criticized mildly, remonstrated gently, importuned urgently, demanded heatedly, and cussed abominably, but the results of all is nix. He only gets mad or peeved and I've got so I hate to go out there, for it's a sure sign of a row."

"You've got a set of gages, haven't you?"

"Yes."

"Why don't you notify Jim that you wont accept any part that doesn't pass your gages?"

"Because if I did, and acted accordingly, you wouldn't get any pumps," was the instant response.

"Do your gages check up with his?"

"Some do and some don't. When they don't, he says mine are wrong and when they do he says that he can't get every piece perfect and that I should make allowances.

"Its all right once in a while, this allowance thing, for I suppose it cannot always be avoided, but it means that I've got to make the work right myself by changing other parts to fit the stuff he dumps on me, and take the blame when a customer raises the devil because he has paid out good money for a second-hand pump.

"I hate to be making this complaint to you, for I have a notion that if a man can't overcome his troubles himself there's something the matter with the man. I've tried hard and faithfully for over a year and have passed up many things that were against my judgment in the hope that they wouldn't happen again, trying all the while to figure out some way to make things break right.

"Now I've got to admit that I'm up against it. Jim is not responsible to me. On the few occasions that I have so far overcome my scruples as to bring obvious errors to your attention you have immediately called in Jim, heard his excuses, smoothed things over for him, and let him get away with it, leaving me to feel that I am a damphool for making a howl about nothing, and likewise a sucker for running to the boss with complaints about another fellow's work.

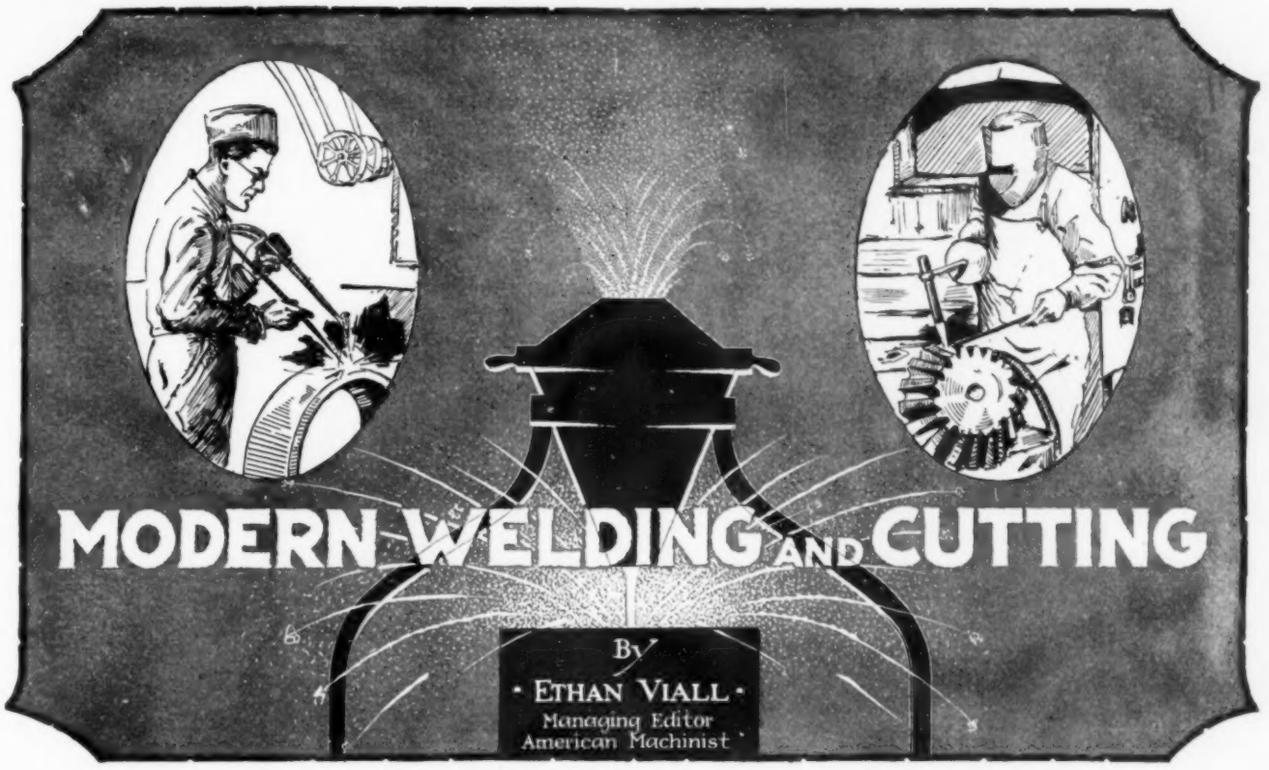
"If I had the privilege of taking the lathe work to the little jobbing shop down the street they would do it just as the drawings specified. They wouldn't ask me why I didn't want it done some other way, or explain that they didn't do it quite right because they didn't have time to read the specifications. I don't believe that the proprieter would bring me up a No. 2 spreader with the shoulders ¼ in. too close together and with an 8-thread on one end and a 10 on the other when both should have been 9 and ask me if I couldn't use it up because his best man was out on a drunk, and the boy he gave it to got all mixed up on it, but he worked 10 hours good and faithful and its a shame to waste all that work, etc., and-so-on etcetery."

Jones' goat was sure loose and out on a regular rampage. The more he talked the madder he got (which was most likely the reason why he was only a foreman) so the old man sought to cool him off by telling him that he would have a talk with Jim. Jones had heard this line of chatter before and knew just what it wouldn't amount to, but he didn't know what to do about it so he did just what nearly everybody does under similar circumstances—nothing.

This didn't happen in my shop—if it had I wouldn't have told you about it. The man really to blame was the superintendent and Jones knew it, but the fear of losing his job, or respect for his official superior, or diffidence, or some other darned thing that is forever handicapping a man and lowering his efficiency and consequent value, prevented him from saying what he knew to be the truth.

The point is that it *does* happen, all too frequently, in many shops; perhaps in yours; very likely in mine. Jones' notion that "if a man can't overcome his troubles himself something is the matter with him," is a good one for us all to adopt but each of us must apply it to himself, never to the other fellow.

Is there friction and discord in your shop? Is any one of your foremen either complaining or struggling quietly along under impossible conditions that only you can mitigate? Of course there *isn't*, but let us look again, just to make sure.



X. The Production of Acetylene*

There are two ways of obtaining acetylene for use in the shop. One is to buy it in cylinders and the other is to generate it on the premises. This article gives some details regarding acetylene in cylinders and also describes the positive-pressure type of generator.

ACETYLENE, which is the gas most commonly used with oxygen for gas-torch welding, is produced by the reaction between calcium carbide and water. It is used because of its large carbon content and also because of its endothermic properties, which means that it is heat absorbing and energy stored up in its formation is given off again upon dissociation. Calcium carbide and water produce acetylene and slacked lime, the formula being: $CaC_2 + 2H_2O = C_2H_2 + CaO(H_2O)$. The calcium carbide when in contact with water is divided and the carbon of the carbide joins with the hydrogen of the water to form acetylene gas. The calcium of the carbide unites with the oxygen of the water and forms slaked or hydrate of lime, as just stated.

Since calcium carbide combines with water in all of its forms it must be protected from moisture in handling. For this reason it is shipped in sealed metal drums or cans commonly holding 100 lb. From these drums the carbide is placed in generators for the purpose of liberating the gas.

Like other gases used for welding or cutting purposes, acetylene may be purchased in cylinders, but it cannot be compressed directly into ordinary steel cylinders with safety. When compressed to as much as 30 lb. per sq.in. it becomes very unstable and liable to explode unless handled with extreme care. The heat generated by compression therefore makes this a dangerous process unless means are provided for cooling. The method used in order to compress the gas and make it safe to handle, is to fill the cylinders with some porous substance and then fill them with acetone. Acetone is a liquid that has the property of absorbing acetylene about the way sugar does water, and acetylene in this state is commonly known as dissolved acetylene. As acetone takes up acetylene it increases in bulk. So suppose a cylinder to be filled only with acetone and dissolved acetylene under considerable pressure. If the cylinder gas valve is opened and some of the acetylene drawn off, the acetone will shrink in volume and leave a place in the cylinder filled with undissolved acetylene gas under pressure. This free acetylene under pressure is very explosive, and easily set off from shock or heat. However, it has been found that the gas will not dissociate when finely divided, and advantage is taken of this, and the cylinder or tank is filled with porous material. For this purpose a mixture of asbestos, charcoal, kieselguhr, and a small amount of cement to hold it together, is packed into the cylinder or tank, providing a finely divided porous filling that prevents dissociation of the gas. After a cylinder has been completely filled with this mixture, slightly dampened, it is baked in an oven until the moisture is completely driven off. It is then exhausted of air and acetone is introduced into the cylinder. Acetylene is then forced into this prepared cylinder, by means of a specially cooled, multiple-stage pump, great care being exercised during the process. Each cubic foot of acetone will absorb 24 cu.ft. of acetylene for each atmosphere (15 lb.) of pressure. However, in actual practice, the quantity of acetone in a cylinder is usually so regulated that the cylinder will contain about 10 times its own volume of acetylene for each atmosphere of pressure that is on

*For the author's forthcoming book "Welding and Cutting."
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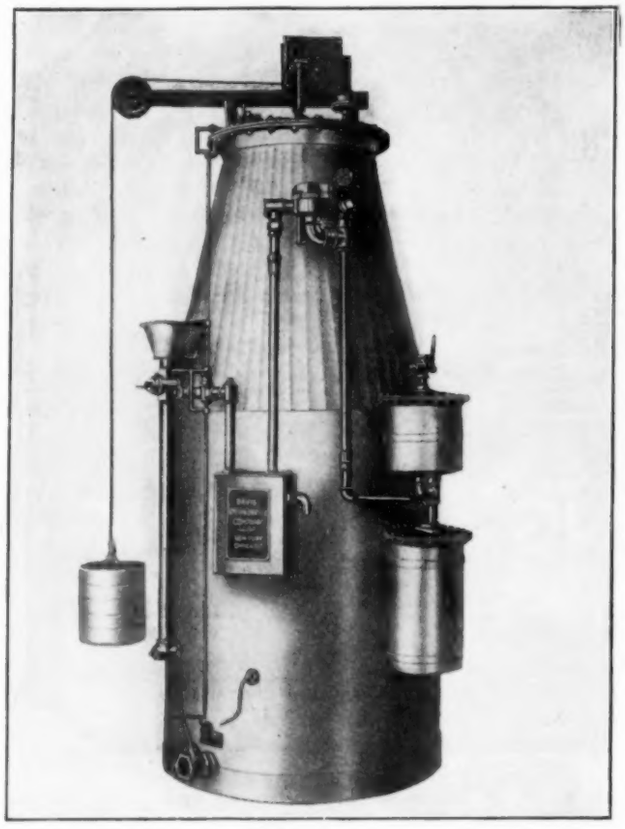

FIG. 95. STATIONARY TYPE OF POSITIVE-PRESSURE ACETYLENE GENERATOR

the gas. Cylinders are, as a rule, charged to 15 atmospheres pressure at 60 deg. F., so they contain 150 times their own volume when charged. Thus a cylinder that would hold 2 cu.ft. of water when empty will hold 300 cu.ft. of acetylene at 225 lb. pressure, 60 deg. F.

The filling material must be so placed in the cylinder as not to settle when handled or shipped, since if it does, a dangerous pocket will be formed filled with free gas. In handling these cylinders, it should always be kept in mind that the pressure increases as the temperature is increased. The best results are obtained by keeping the cylinders of dissolved acetylene at about 60 or 65 deg. F. An average cylinder of about 100 cu.ft. capacity will weigh about 85 lb. and one of 300 cu.ft. capacity, about 220 lb. A Davis-Bournonville cylinder, 12 x 36 in., 225 cu.ft. capacity, will weigh, fully charged, about 180 pounds.

Acetone Injurious to a Weld

Acetone is very injurious to a weld, and in using gas from a cylinder of dissolved acetylene, care must be exercised not to use the gas too fast or acetone will be drawn off with it. The allowable rate of cylinder discharge is at the rate of one-seventh of the capacity per hour. That is, a 225-cu.ft. cylinder will supply $225 \div 7 = 32$ cu.ft. per hour. Under emergency conditions this rate may be considerably exceeded, but the practice is not economical and is liable to injure the weld.

The amount of gas in any cylinder may be found by noting the empty or tare weight stamped on the cylinder, then weighing the cylinder and multiplying the difference in pounds by 14½. In some cases the weight marking may be different, but in any case, each pound by weight of dissolved acetylene, is calculated to produce 14½ cu.ft. of gas. To calculate the amount of acetylene used on any job, weigh the cylinder before and after and multiply the difference in pounds by the number just given. Knowing the cost of a cylinder of gas, the cost of the amount of gas used on any job may be easily found.

Weighing, which has just been outlined, is the only accurate method of computing the amount of acetylene, since gage-pressure readings are affected by changes of temperature. However, gage pressures are a great convenience in *estimating roughly* how much gas remains in a cylinder. In the case of a 100-cu.ft. cylinder, each 15 lb. of pressure represents, approximately, 6½ cu.ft. of gas, and in a 300-cu.ft. cylinder each 15 lb. of pressure represents, approximately, 20 cu.ft. of gas.

There are three types of acetylene generators, the essential differences being the method of bringing the carbide and water into contact. These three methods are: dropping the carbide into the water; allowing the water to rise slowly into the carbide; dropping the

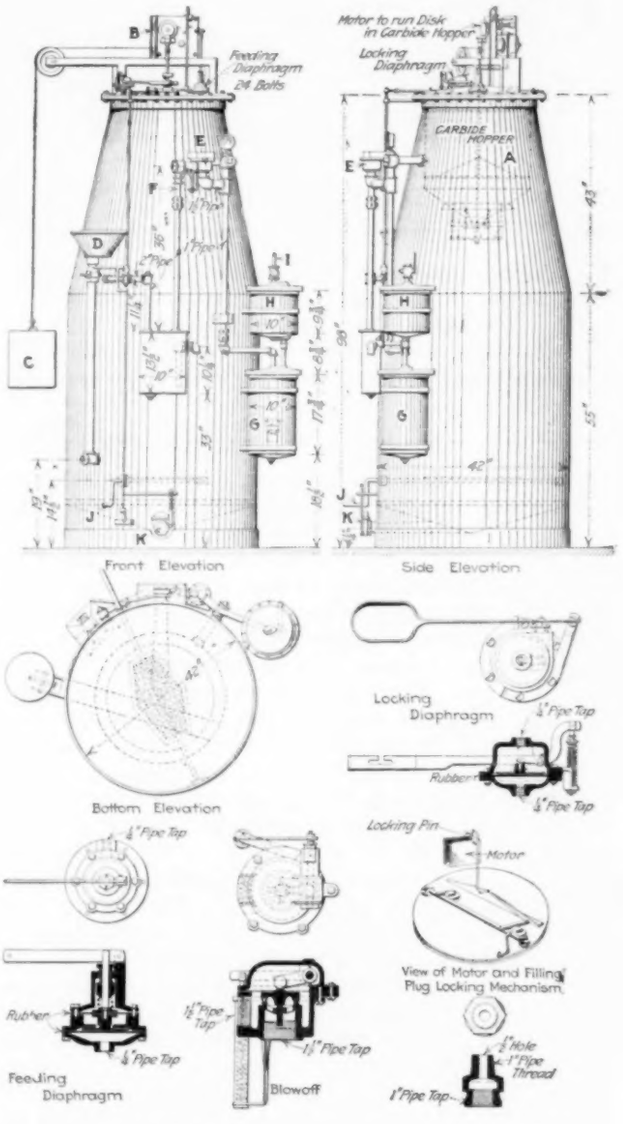

FIG. 96. DETAILS OF 300 LB. CARBIDE CAPACITY ACETYLENE GENERATOR

water onto the carbide. The first is by far the most satisfactory method and the one generally used in the United States, and for this reason will be the only method described.

The carbide-to-water generators are of two types, known as positive- or medium-pressure, generators which deliver the acetylene at a pressure of more than 1 lb. and not to exceed 15 lb., and low-pressure generators which deliver gas at a pressure of less than 1 lb. While there are a number of firms making the different types, only the better known makes will be described in detail, since the general principles are the same. Modern generators of all types are automatic in their action, the feed being regulated by the flow of gas, and they are provided with an ample number of fool-proof devices which render their operation and handling safe.

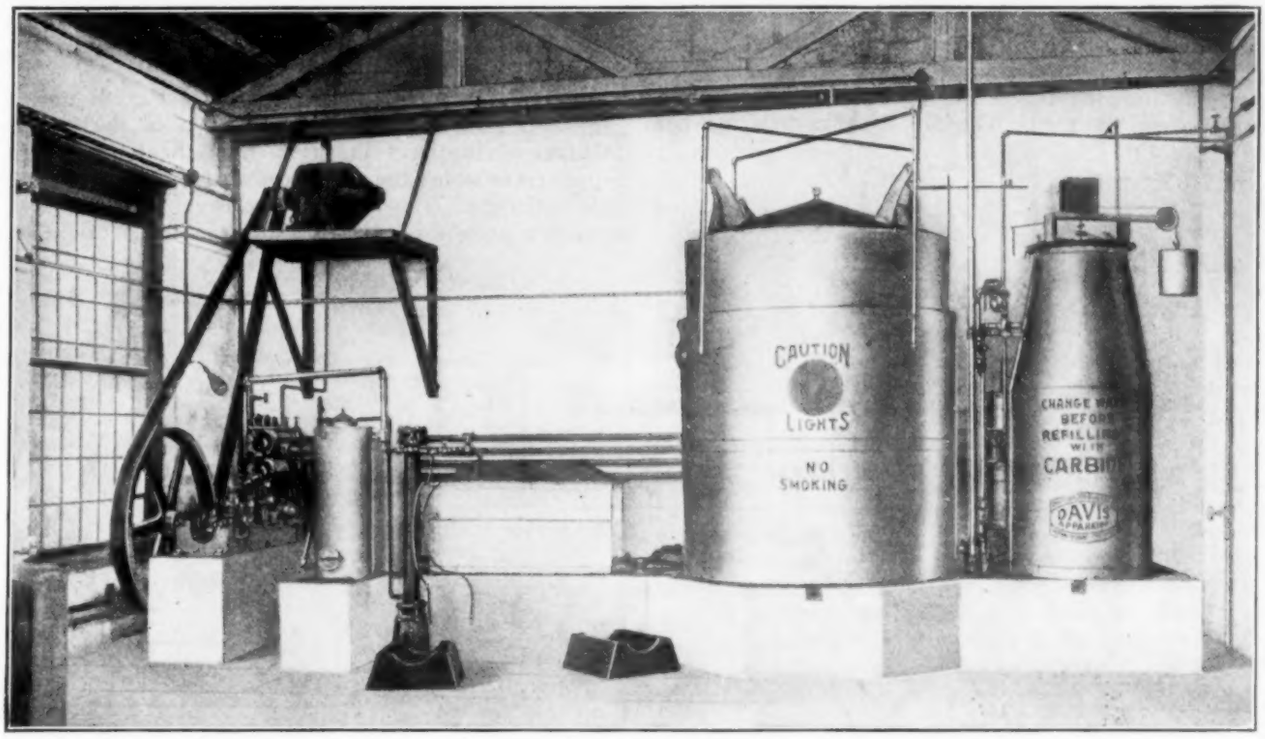

FIG. 97. NAVY TYPE ACETYLENE GENERATING AND COMPRESSING INSTALLATION IN A BETHLEHEM SHIPBUILDING CORPORATION PLANT

The Positive-Pressure Generator

The first positive-pressure generator built was designed by Mr. Bournonville in 1906. The present type of pressure generator handled by the Davis-Bournonville Co., is made by the Davis Acetylene Co., Elkhart, Ind. These generators are made in several sizes to meet the demands of various sized shops, and they may be had in 25, 50, 100, 200 and 300 lb. carbide capacity. These numbers indicate the weight of the charge of calcium carbide to be used, the number of gallons of water per charge, and also the number of allowable cubic feet of gas generated per hour in accordance with the rules of the National Board of Fire Underwriters.

The generators of 50 lb. and 100 lb. capacity are standard for repair shops and light manufacturing, while the larger sizes provide for more extensive and continuous use in large repair shops and metal-working industries. They are of heavy construction with powerful feeding mechanism. They are frequently installed as units to build up plants for any requirements of the oxy-acetylene process. They all have automatic feed with independent power and the quantity of carbide remaining in the hopper is constantly indicated. The acetylene gas is piped directly from the generator under the required pressure through service pipe lines to the welding stations and is regulated by means of reducing valves fitted with pressure gages to govern the proper working pressure.

The size of carbide used in the Davis stationary generators, is designated as $1\frac{1}{4}$ x $\frac{3}{8}$ in., and it is estimated to produce approximately $4\frac{1}{2}$ cu.ft. of acetylene gas to a pound of carbide. The size of carbide just quoted has reference to the size of screen mesh it will go through or not, that is: $1\frac{1}{4}$ by $\frac{3}{8}$ in. means that the lumps will all go through a $1\frac{1}{4}$-in. mesh screen, but none through a $\frac{3}{8}$-in. mesh; carbide quoted as $\frac{1}{4}$ by $\frac{1}{12}$ in. size, will go through a $\frac{1}{4}$-in. mesh screen, but not through a $\frac{1}{12}$-in. mesh, and so on. This smaller size is estimated to yield about 4 cu.ft. of gas per pound of carbide.

The carbide-to-water generators are designed to hold a gallon of water for each pound of carbide capacity. In practice the carbide is fed into the water only in sufficient quantity to maintain the gas supply at the required pressure. The extreme limit of safety pressure for free acetylene is 30 lb. and in the positive-pressure types of generators the pressure limit is placed at 15 lb. When this pressure is reached, the various safety devices begin to act to prevent further generation and consequent increase in pressure. As the carbide is fed from the containing hopper it drops down into the tank of water beneath, and sinks to the bottom. In this way most of the gas is generated close to the bottom of the water tank, and has to rise through a considerable body of water to reach the top. This not only serves to

cool the gas but also washes out a large part of the impurities. The carbide used in these generators may be obtained from distributing points in nearly all of the large cities in the country, in sealed drums containing 100 pounds.

The acetylene generator shown in Fig. 95 is the Davis standard stationary 300 lb. carbide capacity apparatus. It is 115 in. high, 42 in. in diameter, and weighs about 1000 lb. Details of this apparatus are shown in Fig. 96. In this cut, *A* is the hopper into which the carbide is introduced from the top. A feeding mechanism at the bottom of this hopper is run by the clock motor *B*, which is operated by means of the weight *C*. The feeding device consists principally of a rotating disk with inclined vanes which sweep the lumps of carbide off into the water below. There are two safety-pressure diaphragms for stopping the motor should the gas pressure become too high. The first diaphragm acts when the pressure reaches 15 lb. If this should fail to act properly, the second diaphragm will be actuated a little above 15 lb. pressure. This last diaphragm operates a positive lock which effectually stops the motor and consequently the carbide feed. In addition to this, there is a safety valve at *E* which is connected to a pipe leading to the outside of the building, so that the gas can escape in safety. At *D* is a funnel by which water is run into the tank. As the gas is generated it is carried through the pipe *F* to the bottom of the flash-back chamber *G*. This chamber is full of water and serves the double purpose of giving the gas a second washing, and acting as a water seal between the service pipe and the gas in the generator. From this chamber the gas passes up through the filter chamber *H*, which is filled with asbestos that removes suspended impurities. From this filter the gas passes out through valve *I* into the service pipe and thence to the torches. The handle *J* operates the agitator and the tank settlings are removed through the gate valve *K*.

In addition to the regular stationary type, the Davis-Bournonville Co. makes what is called a "Navy Type." These comprise a complete equipment for use in shipbuilding yards, railway systems, and large industries. The installations provide acetylene generation with two-pressure, air-excluding generators of large capacity, supplying acetylene under direct pressure to welding and cutting stations and an additional low-pressure supply for compression into portable safety cylinders, with purification system, and three-stage specially designed acetylene compressor. Three sizes of the navy type, two-pressure, air-excluding acetylene generators are manufactured, having a capacity of 100 lb., 200 lb., and 300 lb. of carbide each, and with normal output of 100, 200 and 300 cu.ft. of acetylene per hour respectively. When greater capacity than 300 cu.ft of acetylene per hour is desired, two or more generators may be connected serially with a special purifying and compressing plant.

A navy type installation is shown in Fig. 97 and a suggested plant layout in Fig. 98. One of the special features of the navy installation, is the low-pressure supply from which the gas is drawn for charging portable cylinders. This is done because in many places around a shipyard or other large plants, it would be practically impossible to pipe the gas or to use a portable generator. The cylinders used are, of course, previously prepared as already outlined. After charging they may be transported to the work in various ways, but for convenience they may be mounted on a small hand truck, like the one shown in Fig. 99. This truck holds an acetylene cylinder and an oxygen cylinder, together with the necessary accessories.

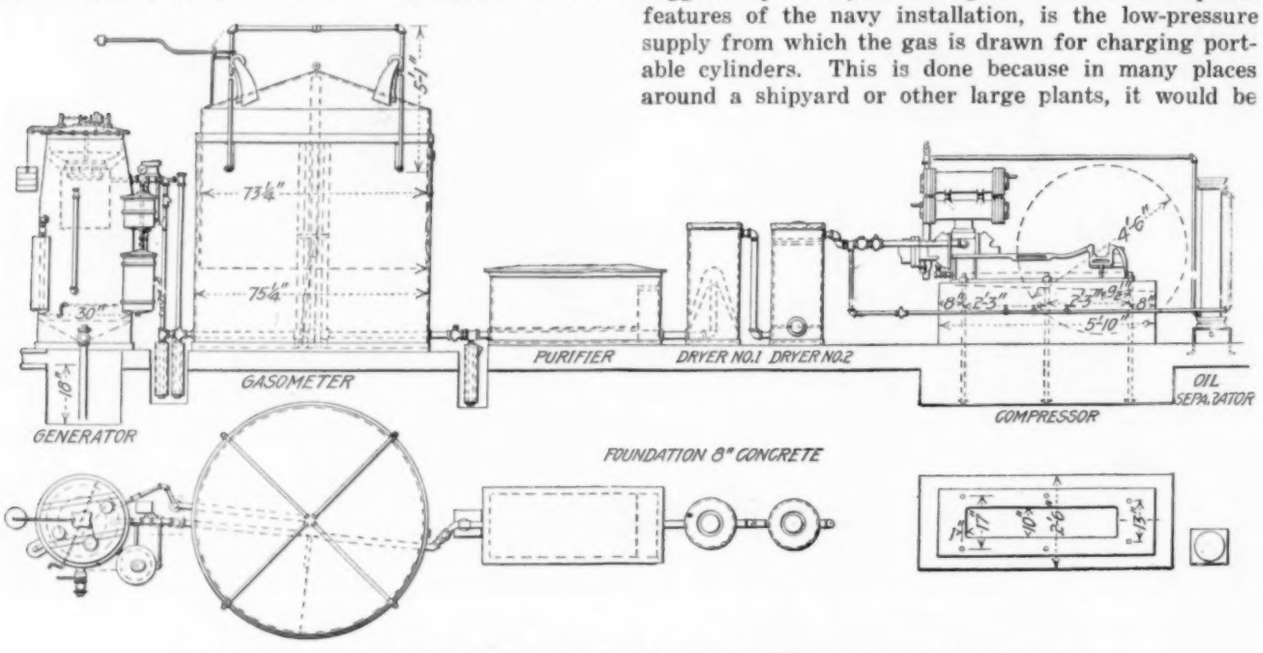

FIG. 98. NAVY TYPE ACETYLENE PLANT LAYOUT LENGTH OVER-ALL 36 FT. 6 IN.

The approximate dimensions and weights of the various types of generators made by the Davis-Bournonville Co. are given in Table VII.

The Buckeye Carbide-Feeding Mechanism

The phantom view given in Fig. 100 illustrates the feeding mechanism used by the Macleod Co., Cincinnati, Ohio, on their pressure generators. These are made on the same principle as those just described, but this illustration gives a clearer idea of the arrangement of the feeding device. The operating motor is driven by a weight which is wound up by means of the handle on top. The way the vanes are set so as to sweep the carbide lumps into the hole in the center of the bottom of the hopper, is clearly shown.

Since commercial demands frequently make a portable type of acetylene pressure-generating apparatus desirable, such apparatus particularly suited to the requirements of large shops, ship or railroad yards and the like, is made by several firms. The Davis Acetylene Co., makes them in two sizes, of 25- and 50-lb. capacity. These generators are provided with a locking mechanism which prevents the operation of the feeding mechanism when the generator is being moved.

The Portable Pressure Type

The portable pressure type of generator made by the Oxweld Acetylene Co., Newark, N. J., and Chicago, Ill., is shown in Fig. 101. These generators are made with 50- and 100-lb. carbide capacity and respective productions of 50 and 100 cu.ft. of acetylene, capable of supplying 3 and 6 torches. The 50-lb. generator is 3 ft. 1 in.

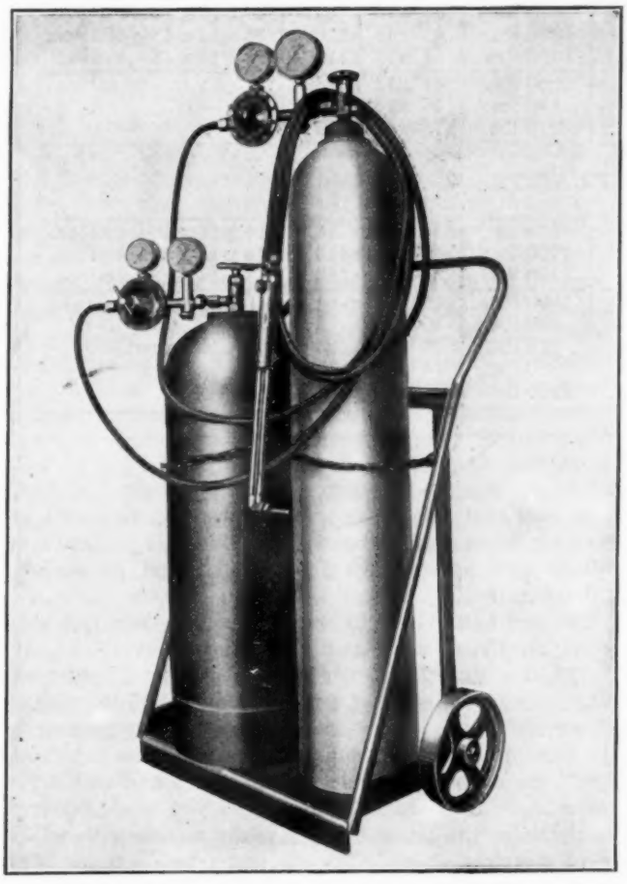

FIG. 99. ALL-STEEL HAND TRUCK FOR HOLDING GAS CYLINDERS AND WELDING OUTFIT

wide, 3 ft. 3 in. long and 5 ft. 8½ in. high. It is mounted on a 4-whceled truck 4 ft. 5 in. wide and 7 ft. 8 in. long, with an over-all height of 6 ft. 11½ in., and a weight of 1750 lb. The 100-lb. size is mounted on a truck 9 ft. 5 in. long, 4 ft. 10 in. wide, has an over-all height of 8 ft. 6 in., and weighs 2300 lb. This type of generator consists of a single shell which contains both the carbide hopper and the generating tank. There is no gasometer, the carbide-feeding mechanism being controlled by the pressure of the generated gas against a flexible diaphragm.

The feeding mechanism is positive in action and is provided with an automatic auxiliary no-pressure stop mechanism which closes the feed opening in case the

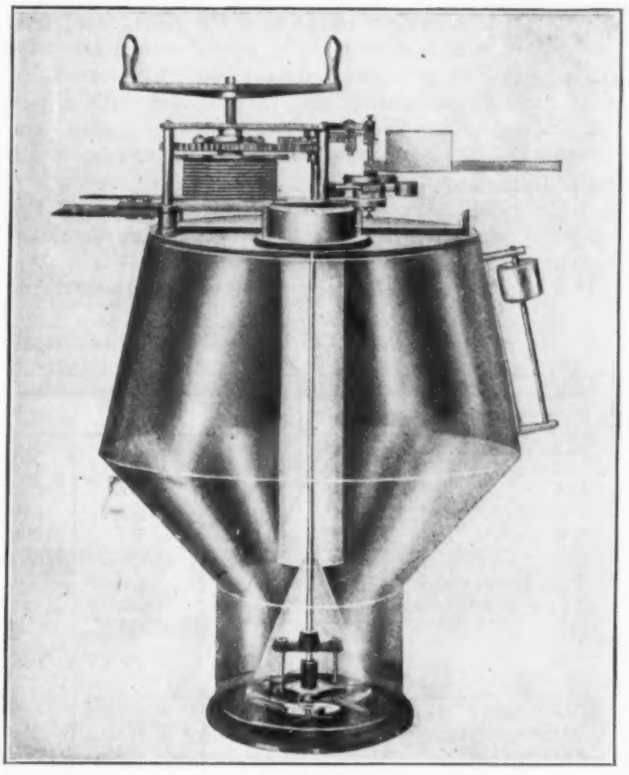

FIG. 100. THE BUCKEYE CARBIDE-FEEDING MECHANISM

pressure in the generator should be reduced to zero through a leak in the line or connections or by reason of any derangement in the controlling device. A locking handwheel positively locks the feed mechanism in its closed position when the generator is out of service or when it is desired to move it from place to place. This effectually prevents any carbide from falling into the water or the water from splashing onto the carbide while the generator is being moved. A complete system

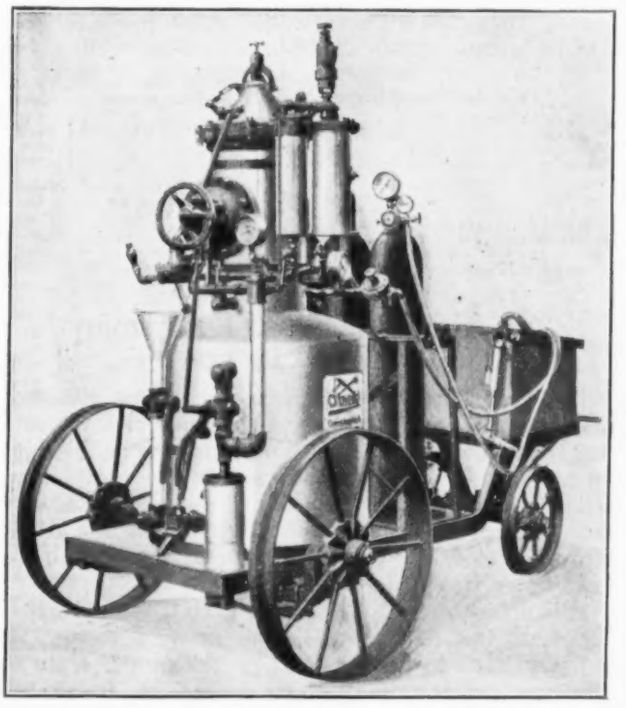

FIG. 101. OXWELD PORTABLE PRESSURE GENERATOR

of interference devices connecting the filling cap, feed mechanism and residuum gate, provides against mistakes in operation. The hydraulic back-pressure valve is of heavy construction and is provided with a pop valve of ample size to carry off any excess pressure. The generator is also provided with a diaphragm relief valve of special design. The filter has a cover which is interlocked with the shut-off cock to prevent the escape of gas when the lid has been removed for cleaning purposes.

The construction of the generator throughout is of a heavy and substantial character. It may be mounted on a 4-wheel truck, as shown in the engraving, or it may be located in a stationary position. Space is provided on the truck for three oxygen cylinders and a tool chest, making the entire equipment self-contained.

This same concern also makes other pressure generators in 200-, 300- and 500-lb. capacities.

Acetylene Generators	Height, Inches	Diameter, Inches	Weight, Lb.
100 lb. carbide capacity	78	30	800
200 lb. carbide capacity	104	36	1000
300 lb. carbide capacity	115	42	1200
Gasometer, 100 cu.ft. capacity	120	76	1500
	Height, Inches	Diameter, Inches	Weight, Lb.
Driers, each	40	16	80
Oil separator	52	6	200
Purifier, 24 x 36 x 74 inches	...	....	800
Compressor, 31 x 36 x 74 inches	...	....	2500

TABLE VII. APPROXIMATE DIMENSIONS AND WEIGHTS OF ACETYLENE GENERATOR SETS

Pressure Generator Capacity	Diameter	Height Over All	Approximate Floor Space	Net Weight	Gross Weight Crated	Dimensions Crated	Motor Weights and Fittings Crated
25 lbs.	18″	54″	4′ x 4′	200 lbs.	300 lbs.	27″x29″x 55″	10 x 10 x 14—150 lbs.
50 lbs.	24″	62″	4′ x 5′	450 lbs.	550 lbs.	34″x36″x 67″	10 x 10 x 14—150 lbs.
100 lbs.	30″	76″	5′ x 6′	550 lbs.	680 lbs.	36″x38″x 80″	10 x 10 x 14—150 lbs.
200 lbs.	37″	104″	6′ x 6′	850 lbs.	1000 lbs.	43″x48″x110″	14 x 14 x 43—400 lbs.
300 lbs.	42″	115″	6′ x 7′	1000 lbs.	1200 lbs.	53″x55″x110″	14 x 14 x 43—400 lbs.
One Torch Unit					60 lbs.	11″x12″x 23″	
Two Torch Units					90 lbs.	14″x15″x 32″	
Three Torch Units					120 lbs.	15″x21″x 32″	
NAVY TYPE PLANTS							
100 lbs.	30″	78″	5′ x 5′	550 lbs.	680 lbs.	34″x38″x 96″	14 x 14 x 43—400 lbs.
200 lbs.	36″	104″	6′ x 6′	850 lbs.	1000 lbs.	46″x48″x110″	14 x 14 x 43—400 lbs.
300 lbs.	42″	115″	6′ x 7′	1000 lbs.	1200 lbs.	53″x55″x110″	14 x 14 x 43—400 lbs.
Gasometer	75″	120″	7′ x 7′	1500 lbs.	1900 lbs.	79″x83″x 94″	(100 c. f. capacity)
Purifier		26″	26″ x 80″	500 lbs.	600 lbs.	30″x30″x 72″	
Dryers	16″	40″	16″ x 24″	80 lbs.	110 lbs.	20″x20″x 24″	(two required)
Separator	6″	52″	12″ x 12 ″	200 lbs.	250 lbs.	14″x14″x 72″	
Compressor		64″	30″ x 112″	2500 lbs.	2900 lbs.	36″x48″x 84″	

An Aid to the Chief Draftsman

By John S. Carpenter

The most of us have heard so much about efficiency that it has become a bore, and one finds that the subject is often the signal to begin yawning when brought up at meetings and conferences. It does not follow, however, that because we have had enough of efficiency that we have exhausted its possibilities. In this article I propose to take to task an old offender who should have "done time" long ago.

It is a fact, regrettable though it is, that the chief is the most inefficient man in the drawing room. He will try hard to get his men to the proper state of efficiency by driving them or by seeking to awaken their interest; but as a rule he does not consider his own working efficiency. Thus it happens that the boss may come in and wonder why it is that the Smith job is not as yet in the shop while the Jones job, which wasn't in any hurry at all, should be already on the cars. Next comes the old story in which the boss tells the chief that he was plainly told to get that Smith job in the shop at once, to which charge the chief enters a general denial.

One of the most efficient and well-liked chief draftsman I ever saw in the course of 14 years in the business made what he called "a work organizer," which helped to explain the secret of his efficiency. I liked it so well that I made one for myself and feel that no drawing room should be without one. It is made as follows and used drawing paper can just as well be utilized as not.

Cut out a top sheet 15 x 12 in. and then cut nine more, all 15 in. wide, but with lengths of 13, 14, 15, 16, 17, 18, 19, 20 and 21 in. respectively. Fold back rather sharply a piece of ½ in. wide on the 15-in. edge of all of the sheets; then fasten the sheets together on the edge opposite the folded tabs so that the tabs project 1 in. over each other. Eyelets are preferable for fastening. Now decide what titles you want lettered on the tabs, the latter being a ready means with which to pick up the sheets. My efficient friend's titles were as follows: "Rush Orders," "Routine Orders," "Repair Jobs," "Propositions," "Revisions to be made," "Under Consideration," "New Designs," and "Supplies to Order."

When the boss gives the chief draftsman an order, he will mention whether it is in a hurry or not, and the papers should then be put in the folder between the proper leaves.

The same applies to all memoranda that usually lie around and cannot be found when wanted. The folder should be gone over thoroughly at least once a day so that its contents are well in mind. In large drawing rooms it will be found profitable to furnish such a work organizer to squad bosses as well, the titles being appropriate to their needs. In this way there should be no excuse for overlooking important items when the whole situation is at one's finger ends.

U.S. ARMY ORDNANCE NEWS

Manufacturing the 9.2-In. Howitzer Shell

BY S. A. HAND.

(*Continued from Page 801, April 24 issue*)

THE construction of the finishing reamer is shown in Fig. 8, and Fig. 9 shows the gages for the diameter of the straight part of the bore.

Before removing the shell from the boring lathe a single-bladed, flat offset-cutter is put in the place of the finishing reamer and fed up bodily against the shell base. This is done so that the bore shall be the proper depth when gaged from the base.

The gage for this is shown at *A*, Fig. 10, and the two limit marks for length may be seen at *B*. After boring has been completed, the heat and serial numbers must be transferred from the body to the now finished base of the shell, otherwise they would be obliterated and so lost to record in turning the outside.

Having the base finished and the proper depth of hole assured, there is often much surplus stock as to length. This must be removed by facing-off the nose. This is an operation that is not on the list, but was made advisable by a change in the type of machines used for rough-turning and time is saved thereby.

To remove the surplus stock from the nose end the shell is mounted on an expanding mandrel in a heavy lathe and a counterfacing cutter fed bodily against it until brought to the proper length.

Previous operations may not have left the hole in the nose and the bore in the shell concentric with each other. To correct this and to make the hole smooth and within close limits as to size the nose must be rebored. This is done in a Foote-Burt upright drilling machine with much the same equipment as used

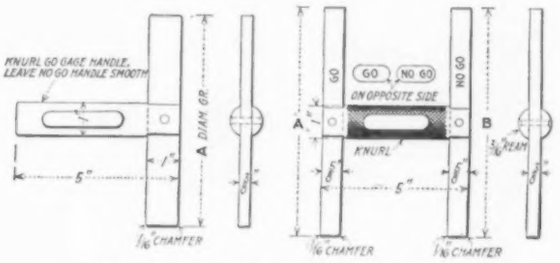

FIG. 9. GAGES FOR DIAMETER

in drilling the nose, as will be seen in Fig. 11. An assembly drawing of this fixture is shown in Fig. 12, which needs no explanation. In place of the jig on the machine column used in drilling the nose, bushings are fitted in the upper ends of the expanding mandrels as

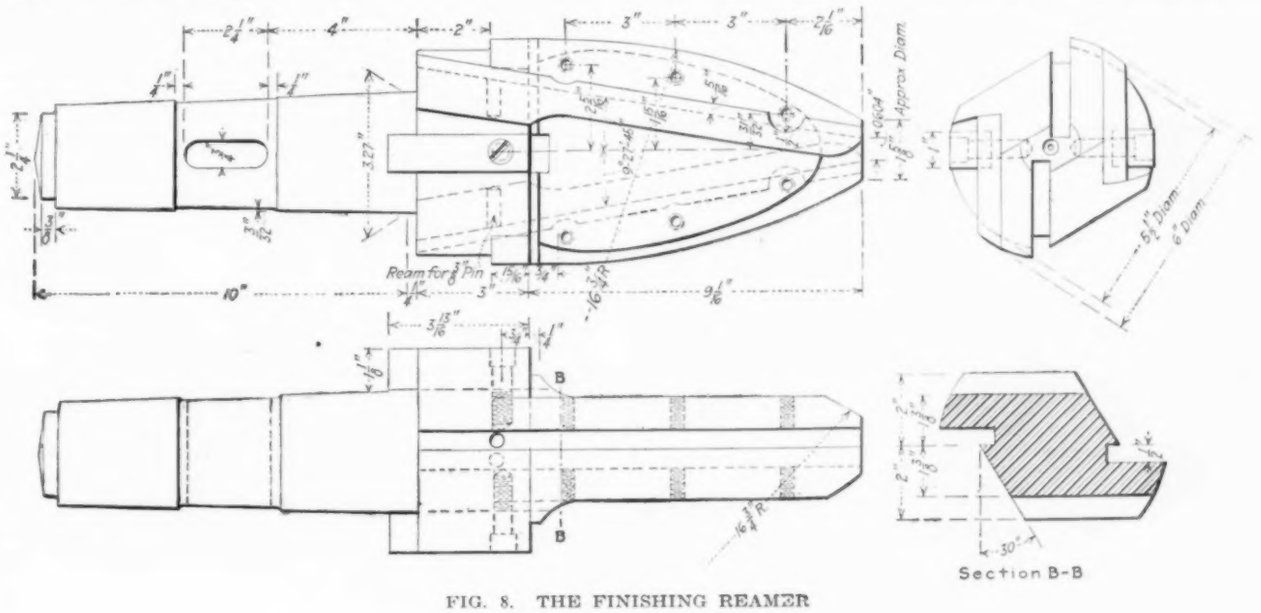

FIG. 8. THE FINISHING REAMER

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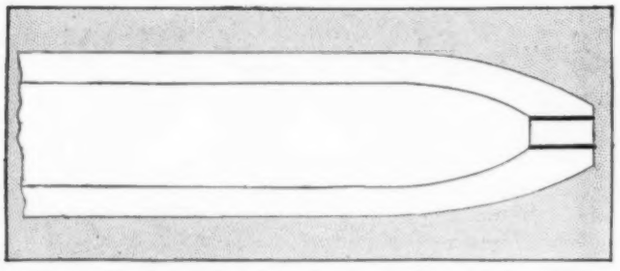
a guide for the boring bar, which is provided with a single-ended high-speed-steel cutter.

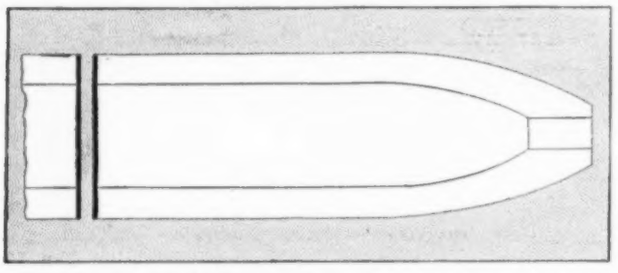
Rough-turning, Fig. 13, is done on a No. 21 Amalgamated lathe, and the shell is mounted on a short pawl mandrel having three heavy, wide blades that bite into the interior of the finished bore. The nose end is supported by and revolves on a hardened-steel plug which fits the hole in the nose and is carried by the tail spindle. Heavy graphite grease is used as a lubricant, and there is no appreciable enlargement of the hole in spite of the heavy cut taken in rough-turning.

The lathe is equipped with a duplex carriage on which two tool slides are mounted. The slide *A* carries the tool for turning the straight part of the shell, and being of the usual construction needs no further description. The slide *B* carries the tool for turning the nose profile. It is pivoted underneath to a free traveling slide and at the rear to a stationary block fastened to the back of the lathe. As the carriage travels longitudinally the tool slide swings upon these pivots and describes an arc.



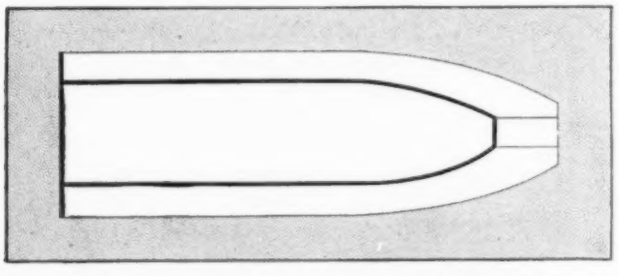
TRANSFORMATION FOR OPERATION 501—DRILL NOSE

Machine—Colburn drilling machine. Number of operators—One. Work-holding device—Lever-operated expanding mandrel. Cutting tool—One $\frac{31}{64}$-in. high-speed twist drill. Number of cuts—One. Cut Data—Speed, 76 ft. per minute; feed, 0.010 in. per revolution. Coolant—Soluble oil. Special Fixtures—Turret with two expanding mandrels on base of machine. Jig for grinding drill on column of machine. Gages—Plug go, 1.656 in.; no-go, 1.676 in. Production—115 per machine in eight hours.



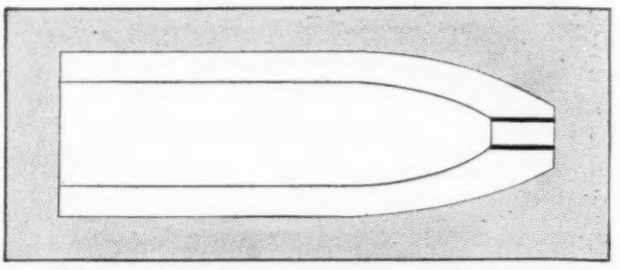
TRANSFORMATION FOR OPERATION 502—CUT OFF TO 24$\frac{3}{4}$ IN. INSIDE

Machine—Williams cutting-off machine. Number of operators—One. Work-holding device—Pot chuck. Cutting tools—Two high-speed cutting-off tools, one at front and one at back. No. of cuts—One. Cut data—Speed, 57 ft. per minute; feed, 0.025 in. per revolution. Coolant—Soluble oil. Special Fixtures—Plug center at rear of chuck to center shell by hole in nose. Gages—Tool-setting and depth. Production—95 per machine in eight hours.



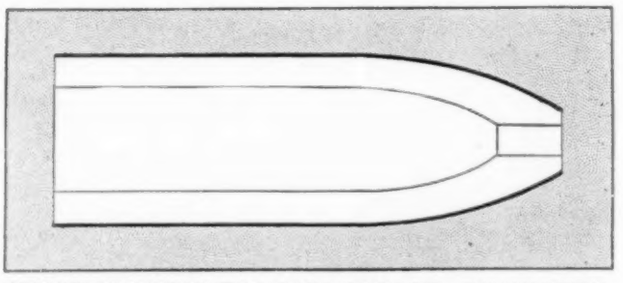
TRANSFORMATION FOR OPERATION 503—ROUGH-AND FINISH-BORE AND FACE BASE

Machine—Amalgamated lathe No. 23. Number of operators—One. Work-holding device—Pot chuck and steadyrest. Cutting tools—Hog-nose drill and finishing reamer both with two high-speed steel blades, one facing tool. Number of cuts—One with each tool. Cut data—Speed, 35 ft. per minute; feed, 0.153 in. per revolution. Coolant—Soluble oil. Special fixtures—Plug center at back of chuck to center nose by hole; plug center in tail spindle to center open end. Gages—Depth with limit lines scribed. Diameter, go, 6.490 in.; no-go, 6.510 in. Production—25 per machine in eight hours.



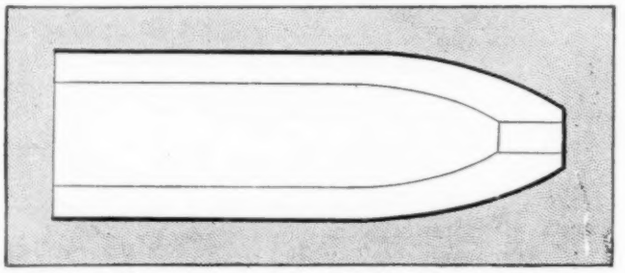
TRANSFORMATION FOR OPERATION 504—REBORE NOSE

Machine—Foote-Burt drilling machine. Number of operators—One. Work-holding device—Lever-operated expanding mandrel. Cutting tool—Single-point high-speed steel, cutter in boring bar. Number of cuts—One. Cut data—Speed, 68 ft. per minute; feed, 0.017 in. per revolution. Coolant—Soluble oil. Special fixtures—Turret with two expanding mandrels on base of machine. Top of mandrels center shell by interior profile and have bushings to guide pilot on boring bar. Gage—Plug, go, 1.775 in.; no-go, 1.785 in. Production—175 per machine in eight hours.



TRANSFORMATION FOR OPERATION 505—ROUGH-TURN

Machine—Amalgamated lathe No. 21. Number of operators—One. Work-holding device—Pawl mandrel with three blades that bite into interior; hardened plug center. Cutting tools—Two high-speed steel. Number of cuts—Two. Cut data—Speed, 45 ft. per minute; feed 0.100 in. per revolution. Coolant—Soluble oil. Special fixtures—Tool slide for profile turning nose, swings on pivot; rear pivoted to radius block. Gages—Profile templet; snap, go, 9.260 in.; no-go, 9.220 in. Production—42 per machine in eight hours.



TRANSFORMATION FOR OPERATION 506—FINISH-TURN. AND TRIM NOSE

Machine—16-in. Fairbanks-Morse lathe. Number of operators—One. Work-holding device—Wrench-operated expanding mandrel with three blades; hardened plug center. Cutting tool—$\frac{1}{2}$-in. square Stellite in holder. Number of cuts—One. Cut data—Speed, 142 ft. per minute; feed, 0.032 in. per revolution. Coolant—Soluble oil. Special fixtures—Profile guide at rear of machine. Gage—Snap, go, 9.155; no-go, 9.150. Production—24 per machine in eight hours.

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The distance from the central pivot to the point of the turning tool is obtained by adjustment of the tool slide, but the distance from the central pivot to the pivot at the rear is predetermined and established by

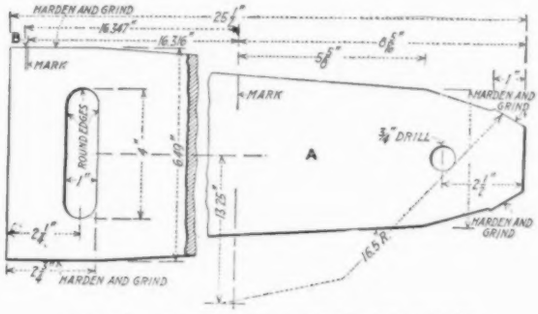

FIG. 10. GAGE FOR DEPTH OF HOLE

direct proportion of the length of the straight part of the shell to the axial length of the nose. It is clearly evident that the radius turning tool, traveling but about one-third of the whole axial length of the shell in the same time the body tool travels the remaining two-thirds, has its feed reduced to about one-half that of the body-turning tool. This is particularly desirable in shell turning, as the feed limit is governed by the excess amount of stock and the greatest eccentricity which is generally found at the nose end. With this arrangement the operator gages his feed by the limits of the tool for the straight cut and the automatically reduced feed of the radius tool will then be well below its maximum limit.

The straight cut on the body of the shell is finished before that on the radius, and an automatic knockout stops the feed at the completion of the latter cut.

Fig. 14 is a detail drawing of the pawl mandrel. The blades *A* are free to move in an angular slot. When their center lines are radial, the tightest grip is obtained. When they are moved 30 deg. ahead of the radial position they release the work. It will be readily seen that a shell placed on this mandrel will be gripped automatically by resistance of the cut against rotation.

The gaging is done while the work is revolving and the wear on the gage points is very great, particularly with green operators, who try the gages oftener than

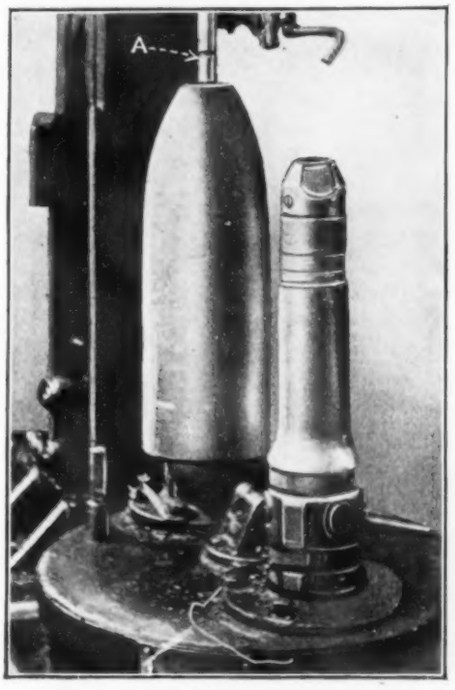

FIG. 11. REBORING THE NOSE

the experienced ones. Green operators often get the gages caught on the revolving shell, with the result that they are either bent or broken. To overcome this difficulty some gages have been made with the contact pins solid on one jaw only. On the other jaw they

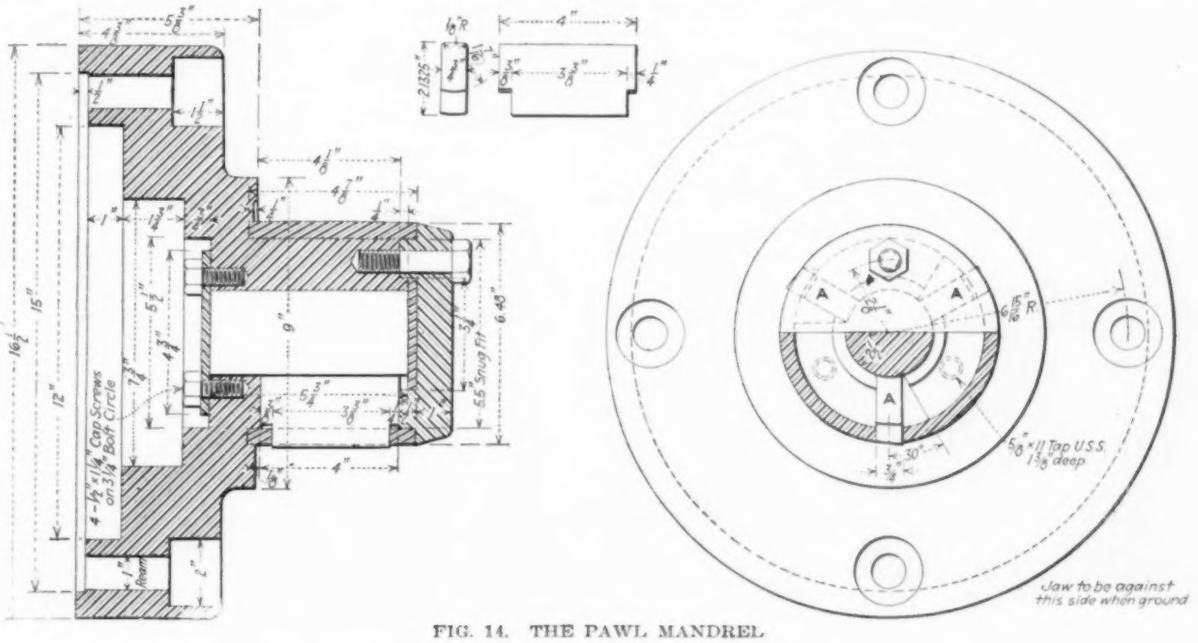

FIG. 14. THE PAWL MANDREL

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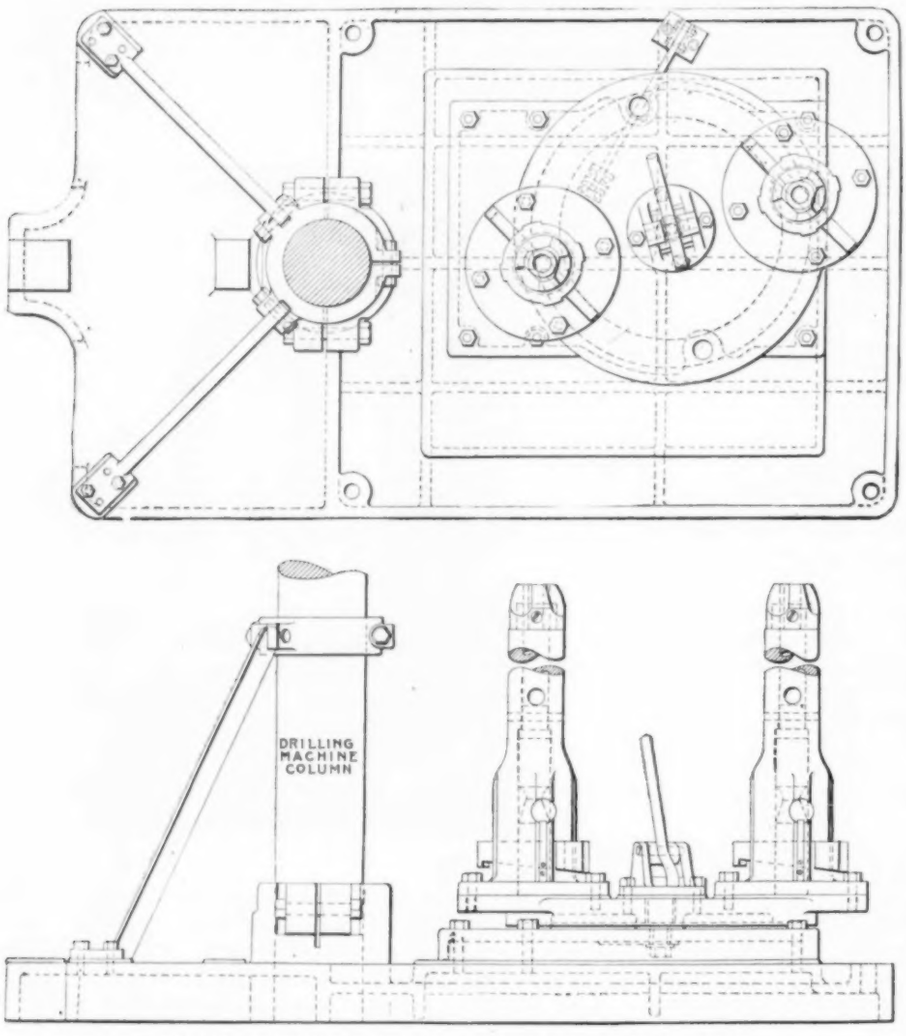


FIG. 12. TURRET FIXTURE FOR REBORING THE NOSE

are pushed out against stops by spiral springs. While gages so constructed are much safer from injury than are solid gages, the experienced operators prefer the solid gages. After rough-turning, the burrs raised on the interior by the bite of the mandrel blades are ground off by the use of a portable electric grinding machine having a flexible shaft. This is done while the shell is on the bench and is necessary for two very important reasons. First, that the expanding blades on the mandrel used for finish-turning will not by any chance rest on the top of any such burrs and so throw the shell out of true, and, second, to prevent premature discharge of the explosive charge.

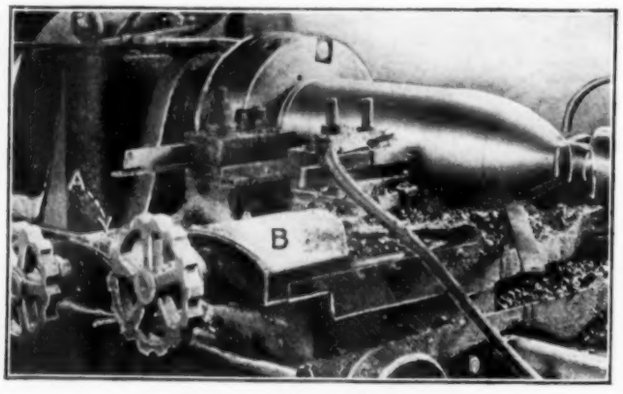


FIG. 13. ROUGH-TURNING

POURING THE EXPLOSIVE

The explosive charge is poured into the shell when in a molten state and when it cools it shrinks so that it is loose in the bore. In firing the gun the twist of the rifling starts to revolve the shell both rapidly and suddenly. As it is some appreciable time before the inertia of the explosive charge is overcome the shell is revolving around the stationary charge during the interval and any burrs might scrape or cut the charge and generate enough heat to cause its premature explosion.

FINISH-TURNING

Finish-turning is done in a Fairbanks-Morse 16-in. lathe, and the shell is held on a short expanding mandrel provided with four wide blades expanded by a wrench. These blades do not bite into the interior surface of the shell as do those in the rough-turning operation. As the cut is comparatively light the friction of the blades when tightly expanded against the interior of the shell

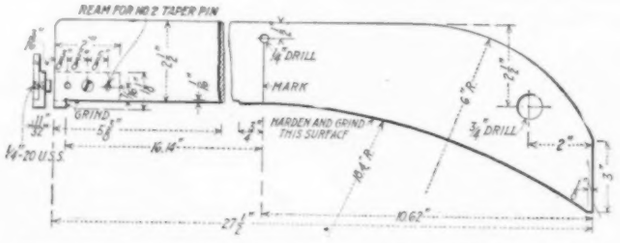


FIG. 15. COMBINED PROFILE AND LENGTH GAGE

is sufficient to resist the pressure of the cut. A single tool is used and the lathe is equipped with a profile guide at the rear. A roller attached to the free slide underneath the regular tool slide and engaging in the slot of the profile guide governs the shape turned. The diameter gages are similar to those used in rough-turning. The combined profile and length gage is shown in Fig. 15.

Getting a Share of General Machine Shop Work

By L. W. ALWYN-SCHMIDT

Peace-time reconstruction problems are no less engrossing to the machine shop than to the rest of the country. On the contrary they are probably more vital to many a shop which has been working entirely or in part on war work. If your old market has suffered from the war, new work must be obtained in the near future if your organization is to be held together. Your share is waiting if you know how to get it.

THE war has brought to the machine shops of this country a considerable increase in general machine-shop work, with the result that a good deal of new equipment required for this kind of work has been added to the general machine equipment of the nation. Now, when the war has come to an end, there is some heartburning that this additional equipment should go begging for a job or that it may land in the scrap heap. Fortunately there is every chance that sufficient work can be found for all the existing production facilities, provided our machine-shop men are willing to accept it at commercial rates.

So far there is very little evidence of a slackening down in the machine-shop industry. Glancing over the advertising pages of the technical and general press there is no noticeable increase in the advertisements of machine shops looking for work, and manufacturers who can place work of this character do not find machine shops ready to accept new business on short notice. This need not cause any surprise, considering the general situation in the country. It is proposed to complete the original shipping program, and the Secretary of the Navy has only recently announced an additional building program. There is a good demand for industrial machinery from all parts of the country, and the resumption of building activity which is expected in the near future must bring many orders to the machine shops. All this follows historic precedent, most big wars having been succeeded by a period of great industrial activity.

Industrial conditions like those expected to prevail during the next two years always bring much business to the general machine shops. As the influx of orders in the specialized industries becomes too large to be handled by the special shops overflow work goes to the general-construction shops, so that the outlook for this branch of the industry seems to be very favorable. What can the individual machine shop do to attract that part of the general machine-shop business which it is able to carry?

General Machine Shop Sells Service

Campaigning for contract work is always a difficult matter for a general machine shop. A machine shop of this character is very much in the position of an ordinary wage earner. It hires its services out to others who want to pay for it, but the quantity of these services is limited by the size and equipment of the shop. Dependent upon the capacity of the equipment is also the earning power of the establishment. Here again the comparison with an ordinary workingman holds good. Having only one pair of hands he can not multiply their productive capacity, but he can improve upon their efficiency by using his brain. As the increase in brain efficiency enlarges the income of a man, so quality of output may add to the earning capacity of the machine shop. It is well worth while to keep this in mind because the lessons to be learned from it must form the basis of all business-promotion work of the average machine shop.

The limitations put on the output and turnover of the establishment by its size and equipment also limit the exertions that can be made for the purpose of obtaining new business. Take, for instance, an establishment able to turn out $100,000 worth of labor, which means approximately $16,000 profit, the profit in such shops of course varying a good deal with the character of the work. Such a shop can hardly spend more than $4000 on the acquisition of new work, and it cannot make use of more work than it is able to handle. The effort therefore must correspond to the results that are desired. It should neither be too small and court failure nor should it exceed reasonable limits in cost. How to attain the proper balance is a problem which so far does not seem to have found a satisfactory solution.

Two Principal Talking Points

The man in charge of the trade-promotion end of a general machine shop has two principal talking points. One is the efficiency of the equipment of the shop, the other the quality of the expert knowledge of its engineering staff. These two he must play for all they are worth. If he does his work well he knows that he is bound to get his share of the general trade coming into the market. He certainly will get business during a time when much engineering work is in demand. He may, however, be less successful in times when work is scarce. Then he will have to show his mettle and ordinary business methods will not succeed. During busy times engineering contractors will be glad to get any sort of shop to do their work, but only the most efficient and well-conducted enterprises can count on keeping going fully when business slows down. It is, however, during such times that machine shops are putting forward their best effort to get new work.

The head of a small but perfectly organized general machine shop doing practically only job work once explained his business-promotion policy to me as follows: "During normal times or when business is active and there is a great demand for engineering we follow the general run of the market and take everything that comes along at a paying rate. We simply advertise that we are ready for taking work. During slack times we specialize. We tell the people that we are doing something better than others, and we pick our orders from a small but well-paying field." This is business wisdom for the engineering shop in a nutshell. It explains why general advertising pays during busy times but brings little return when business is slack all round.

Business at the present moment is still brisk, and

trade-promotion work in the machine shops therefore may proceed on general lines. The advertisements appearing in the press announcing the willingness of engineering shops to accept new or additional work for this reason seem to be the correct way of procedure. They must bring some results and they probably will bring enough work to keep the shops busy and allow the continued employment of the additional equipment.

The wise machine-shop manager, however, looks ahead for the time when business will not be as brisk as it is today and when active promotion work will have to be done to get new work for the machines and men in his charge. To slacken down with production work is a dangerous thing. Not only is it a loss to the establishment to have its machine equipment idle, but the value of a machine shop as a job worker often depends on the training and quality of its labor force. To keep the latter together necessitates continuous employment. A man who knows that his job has the chance of permanency is a better worker than the one who fears being laid off, and the men find out quickly enough how they are placed in this respect. It is a well-known fact that a permanent job commands a better type of men than an occasional one.

The Machine Shop With a Policy

The first step to be taken is that of deciding on a policy to be followed in the general trade-promotion work of the shop. Most shops go along without a special policy. They manage with one or two outside men whose business it is to keep things going and who are asked to do some more hustling when things get slow. The reputation of such shops is rarely their own. If they are left suddenly by their outside men they find only too often that the good-will of the concern belongs entirely to the salesman and leaves with him. It was the personality of the salesman which carried the trade, and the fact that he was well backed up by the shop had very little weight with the customer. A machine shop therefore should have a policy of its own. It should be, in the imagination of the customer, not a thing far removed from personal contact but a live entity with a will of its own. It should have a personality independent of the personal force it exerts by way of its salesmen. To give a machine shop such a policy often requires a genius, but it can be done. Buying engineers often have an instinct of discovering the shop with a policy by merely handling a part made in such a shop, and the shop which has gained this distinction has rarely to go begging for work. It is soon known all over the market.

A distinctive policy can never be carried through by a machine shop unless it has at its disposal first-class engineers, men and equipment. All must be in sympathy with the aims to be attained. It may be the policy of the shop to take only high-class work or cheaper work, or both. It does not matter much which policy is adopted; the principal condition is that the policy once established must be carried out.

If it does not matter what policy is selected why trouble at all about selecting one? Why not go along in a happy-go-lucky fashion and pick up what comes along in the way of a job? The answer to the question is decidedly to "do as you please" as long as you stick to your purpose; but not to hold yourself out today as taking only first-class work and run tomorrow after a cheap job of some sort. There is a psychological influence at work in the mind of the customer which acts in favor of the shop with a declared policy. The customer having some cheap work to be done will call on Walter & Co. because he knows they are handling that kind of work, or he will go to Smith Bros. because he knows they take anything as long as it pays. But he will not call on Miller & Co. who said they would handle everything and then told him they would take only first-class work.

Powerful Factor in Distribution

This disposition of the buyer is a powerful factor in the distribution of general engineering work all over the world. It has succeeded for years in bringing a good deal of first-class work into the machine shops of England, and it has turned much cheap work in the direction of Germany. If a machine shop declares itself for a policy it is bound to get a regular share of all the general contract work that is available.

Like labor general contract work seems to be a commodity for which there is always only a certain limited demand. This demand depends on conditions over which neither labor nor the general contractor has any particular influence. If the demand is filled neither low prices nor any other inducement will help to expand it. But whether the demand is large or small it is always graded in standards. There is a demand both for first-class and cheap work. Both have a tendency to flow to him who holds himself out as being particularly fit in one or the other direction. The undecided gets only what is left over after the shops with a declared policy have got their fill. To possess a production policy is a real and valuable asset in the good-will of a machine shop.

Driving Home Your Point With the Customer

Having once decided upon a policy the next step to be taken is to make known this fact and to connect with firms likely to have use for a shop of this particular customer. The policy of the shop therefore should not only be made a talking point with the outside men, but it should also find expression in the advertising and general publicity of that shop. Most up-to-date engineering and general machine shops are doing today a certain amount of technical-press advertising.

Considering the large amounts of money which are spent annually for this purpose it is often astonishing to see how little many firms are making out of the space they hire. Advertisements containing a mere general wording such as

Miller & Co.
Engineering and General Machine-Shop Work
X St., X City.

are frequently seen. Such an advertisement conveys little to the reader. It does not give an impression of the size of the shop, its capacity and special character; in fact it leaves no impression at all. It is forgotten as soon as read and will rarely be referred to if the reader should some day require the service of a machine shop. There is much reason to believe that advertising of this character does not pay.

To make general machine-shop advertising an effective medium in the general sales campaign of the shop

the advertisement must carry a certain distinction, as for instance:

> Miller & Co.
> General Engineering Works
> X Street, X City.
> We are open to undertake special work of a high-class character beginning from Jan. 15, 1919.

There is a suggestion in this advertisement of dignity and prosperity. The new work can be accepted only after a certain date, which implies that the shop is busy at present. For permanent advertising wording similar in character should be selected. So, for instance, runs the advertisement of a well-known British-Colonial engineering shop:

> Quality in Machine-Shop Work.
> Our force of 200 men supported by the most modern equipment of European and American machine tools working under the supervision of well-trained construction engineers is at your service.
> Write for our booklet, "Shop Service."

This booklet, "Shop Service," is sent free of charge to all who ask for it. It is a 24-page affair in a stiff cover and well illustrated. Its contents impress the reader that the work done by the firm is accomplished by a first-class organization of engineers supported by a first-class shop. To convey this impression photographs are reproduced showing the offices and the workshops of the establishment. There is a list of all the principal machine tools found in the various shops, some of which are shown in illustrations, and one section of the booklet is reserved for a description of the general welfare work of the firm among its employees. The whole publication leaves with the reader the feeling that he deals with a well-conducted establishment and that he places his interests in able hands when he transfers his custom to it. Service being the principal commodity sold by the machine shop to its customer the quality of service is the mainstay in the advertising campaign of this firm.

The offer of service, however, is only acceptable to the customer if services are just then required and if the character of the service is of that kind which is needed by the customer. The advertisements in the technical press reach a great number of readers only a few of whom can be interested in the special offer of that shop. And among these few there are only a still smaller number which may have a use for the special character of the service provided. It is this small number of likely customers which the advertisement must attract. Therefore it cannot be too personal. It must convey in the small space that is available the whole character of the advertiser and tell the reader that this is the shop he must connect with if he wants to have his work well done. This impression of personality and character must further be strengthened by the personal appeal of the outside men. They must drive home the policy emanating from the advertisement so that it is finally settled in the mind of the prospective customer.

What applies to the talk of the salesmen, to the advertisements and to the advertising literature applies with equal force to all other forms of active propaganda: to letter heads, to the paper selected for these, to the style of the letters, even to the conversations over the telephone. All tend to create a certain atmosphere, the existence and strength of which must decide what the share of the establishment in the general contract work in that particular market will be.

All this work naturally is done with one aim in view —that of attracting the right sort of work to the shop, meaning that sort of work for which it is particularly equipped and which therefore it will do best. To connect the demand with that source of supply which is best fitted to satisfy it is the big problem of all commercial activity. Everything that can be done to facilitate this meeting will aid the general efficiency of the nation.

The clever business-promotion engineer will know the abilities of his plant. To be entirely successful he must also know his market. He must know which of the many possible customers for the services of his organization are likely to be most interested in the particular quality of the services that can be rendered. As already explained there is as a rule little trouble in finding the right work during generally busy times. This then is the proper time for collecting all the information that will be required in the future. When business slows down and when specialization in production may become advisable it is of advantage to know beforehand which field is likely to bring the best orders and holds the best prospect for permanency of employment.

To facilitate this selection a trade index is of considerable value. The preparation of such an index by itself is not a difficult matter. First a list is made of all likely customers in the district or the special market of the machine shop. Some discrimination will have to be used during this part of the work in order to include in this list only those names which give a fair promise for later success. If every advertising manager would go to the trouble of studying all his prospects he would be astonished how small their number really is and how large an amount of money is wasted every year by mailing advertising matter to firms which hold a very remote prospect of becoming customers. The original list of prospects therefore has to be cut down a good deal until a working list of a few thousand names is established, which, by the way, represents a fairly good-sized market.

Creating Additional Trade Outlets

The special wants and conditions of each of these firms must be made the subject of an intimate study. The outside men of the shop must be instructed to collect all possible information on each, as, for instance the character of the work done by the prospect, its commercial connections, its machine equipment if it is a manufacturing firm, the standard of the engineering staff and similar points likely to be of interest in the future approach of the prospect. All this information is carefully indexed and preserved for reference. It takes some time before such an index can be provided, and the work on it naturally never ceases. New prospects will have to be added constantly and others withdrawn.

The firms indexed in this way are the trade outlets of the shop; they form the immediate medium by which it hitches itself to the general prosperity of the country. The rule of averages tells us that if we work persistently on a certain number of firms which in their

character are such as to hold a promise of later business, a part of their business must finally accrue to us. This effort must consist in having each of these prospects visited at certain intervals, in order to offer the rule of averages a chance to work in favor of the shop, and in a judicious use of the mails. Let the mail campaign be uniform with all your other campaigning methods; let it be a permanent expression of the shop's policies. Only a few days ago I received from a Western concern a New Year's greeting which, out of a pile of similar greetings, will not be forgotten for quite a while.

SELECTING PROSPECTS

It was a short greeting, a welcome to peace worded by a gifted writer, with a direct human appeal in it, printed in a distinctive type on a high-class bond paper. It wound up with, "We have done our duty to the nation. We are now released by the Government and we are ready to accept other work again. Our equipment, largely extended during the last years, is as perfect as can be. It is at your service."

High-class printing entails considerable expense. Hence the necessity in the interest of economical advertising of not wasting it. Therefore pick your prospects well and concentrate your efforts. There are only a limited number of firms which have use for your special service, but there are also only few machine shops which can render the identical service provided by your organization, so the interest of establishing a connection is mutual.

The man in need of your service will be only too grateful if you bring it to his notice. This is especially true if the customer has some special work to be performed. It is a good plan therefore to keep a watch on all public work coming in the market. Much of this work is contracted for by public contractors, and later part of it is subcontracted to firms especially fitted to do the particular end of it. To approach a firm of this character just at the moment when the issue of the subcontracts is contemplated means entering the field at the psychological moment, when there is most chance to obtain the order. To know those among one's prospective customers who have taken on public work or any other large work likely to require outside assistance is of great help in getting business of this sort and must be made part of the general trade-promotion work of a general machine shop.

In all these cases it is always best to approach the likely customer with a ready-made offer stating exactly what particular service can be rendered by the shop and why the shop is especially suitable for that purpose. It is in just such a case where having an established shop policy comes in most handy. No long explanations are required. The customer is inclined to take the view of the shop's representatives because subconsciously he is convinced of the ability of the shop to do the work. The policy of the shop impressed upon the prospect by the earlier campaign scores.

Getting a share of the general contract work means nothing but giving an engineering shop that place in the general industrial activity of the nation to which it is entitled by its equipment and the character of its service. Keep moving and go with the market. Get a reputation for the kind of work done in your particular line and orders soon will take care of themselves. It is by way of the live wires that the nation's business is conducted.

Incorrect Lead of a Die

BY J. B. GRAY

On page 634 of the *American Machinist*, O. F. Kuhlman tells of a threading job on some ⅞-in. studs, wherein the die cut a lead less than itself. Mr. Kuhlman, however, merely states the matter as a sort of mechanical curiosity, and as he offers no explanation he may be somewhat mystified by the action of the die. If so, the following is the "reason why": The lead of the die itself was no doubt quite correct and the trouble was due altogether to the stock being threaded.

It is one of the peculiarities of dies of all kinds that if the stock being threaded is a trifle large as to diameter, the die will crowd, so to speak, and while it will pass over the work, a nut of corresponding pitch will not. As Mr. Kuhlman speaks of having obtained all kinds of fits, it is probable that his lathe hand turned down the pieces and roughed out the threads rather carelessly, and the difference in the fits obtained from the die vary in accordance with the variation in the studs from the lathe.

The ⅞-in. studs should have been turned down to about 0.865 in. or even a few thousandths under, and that would have compensated for the tendency of the die to force the stock up between the cutting points, thus increasing the diameter of the work. If a number of studs have been carelessly roughed out the amount of stock crowding the die will not be the same and the tendency to retard the die will vary, causing the die to finish threads more or less incorrect as to lead.

I have had this same difficulty not only with hand dies but also with die-heads on screw machines, and I have always found that oversize stock will result in a false lead, while stock that is slightly undersize will thread nicely.

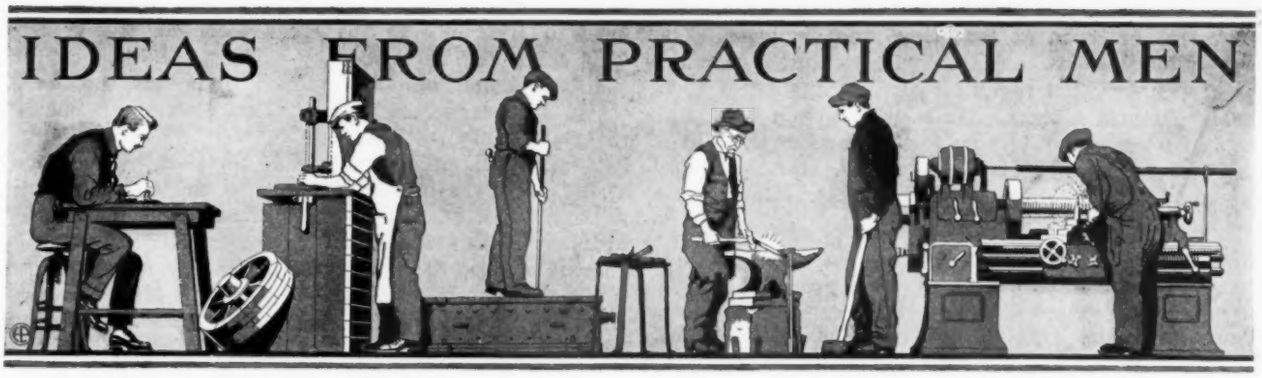
Mr. Kuhlman is really lucky; I have seen screw-machine dies lose one thread in a 2-in. run, due solely to the stock being six or eight thousandths over size.

Should the Loose Pulley Be Smaller in Diameter Than Its Mate?

BY H. D. BLOCK

I have noticed that nearly all countershafts furnished with new machine tools are equipped with the tight and loose pulleys of different diameters. This custom, I believe, is bad practice by reason of injury caused to the belts when they are shifted. While it is true that the bearings are relieved when the belt is on the loose pulley, this does not offset the loss caused by injury to the belt in climbing over the step, or loss in output of machine through slippage caused by loss of contact on the pulley when the edge of the belt is stretched.

In most all cases the countershaft with tight and loose pulleys of the same size will give better results and prove to be the most economical. A belt does not have to be very tight to pull properly if it is kept clean and pliable and proper attention is given to the lubrication. If machine manufacturers would experiment with both kinds of countershafts, they would soon conclude that making the tight and loose pulleys of a different size is good for the belt manufacturers only.

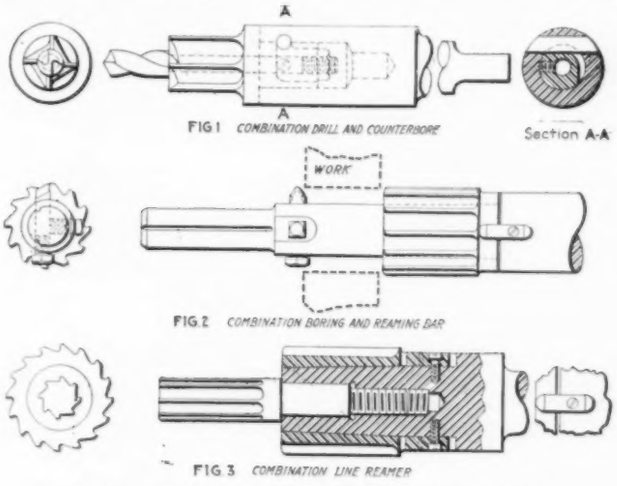


Combination Tools

By W. P. Lotz

Combination tools of various sorts are in common enough use to make comment on their advantages unnecessary. Three examples of this type of tool which have been satisfactory are shown in the figures.

The combination drill and counterbore of Fig. 1 was designed to save time by eliminating spindle changes and is applicable to lathe or screw machine. The drill shank runs through the counterbore and is held in by



FIGS. 1 TO 3. SOME COMBINATION TOOLS

Fig. 1—Combination drill and counterbore. Fig. 2—Combination boring and reaming bar. Fig. 3—Combination line reamer

a nut on the threaded end which should have the threads carried down far enough to allow the drill shank to enter the counterbore as material is removed from the latter in sharpening. The drill is kept from slipping by the small setscrew which bears on the flat, and the counterbore is held in the shank by a device which acts in the same manner as a bayonet lock and must be given a quarter turn to the left before it can be removed.

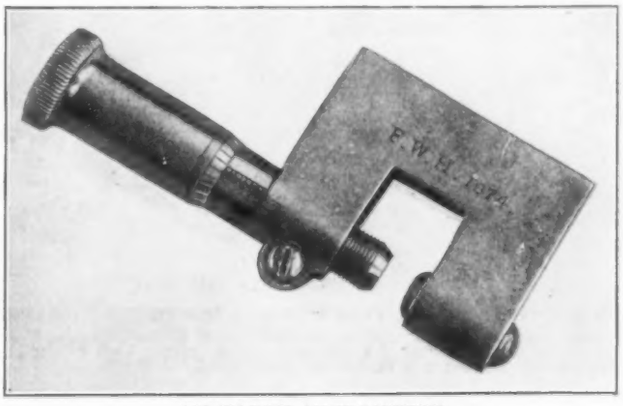
Fig. 2 shows a combination boring and reaming bar which was used in a turret lathe but which could be adapted to use in a drilling machine or boring mill by the addition of a fixture and end support. The pilot on the end of the tool reaches in to a supporting bushing in the spindle. The boring tool is a single-point tool backed up by an adjusting screw and held by a setscrew as shown, and the ordinary type of shell reamer with a taper hole is locked in position by driving keys. To prevent chatter marks the boring tool must be far enough ahead of the reamer so that it has cleared the work before the reamer starts.

On jobs which call for different sizes of holes in line a properly designed combination line reamer saves time and increases accuracy. Fig. 3 shows such a tool with a shell reamer mounted on a taper and held by locking keys as in Fig. 2. The smaller reamer has a straight shank which fits a ground hole in the tool body and a threaded extension which screws into the tapped hole shown. The difficulty in true lining up of the two reamers usually encountered in making tools of this sort is not met with in this design, and the replacement feature makes it much more valuable than the solid combination tool which must be discarded when one reamer is worn out.

A Micrometer of Early Vintage

By Ellsworth Sheldon

While the micrometer shown in the accompanying picture is not exactly a pioneer it was made in the days when such tools were rare. Micrometers were first made commercially in this country in 1867 by the Brown & Sharpe Co., so that the maker of this one probably had one of them as his model, but the fact that a really



AN EARLY MICROMETER

serviceable tool of this nature was made as early as 1874 in a shop whose principal business was the building of steam engines and mill machinery is worthy of note.

The frame of the micrometer, together with the barrel, is sawed from a block of tool steel, the piece being then swung up to turn the barrel, and bore and tap for the measuring screw. The frame is split at the threaded part and fitted with a transverse screw for adjustment. The thread of the measuring screw is exposed as in the commercial tool of that period, the desirability of protecting it not being then so apparent as it became later.

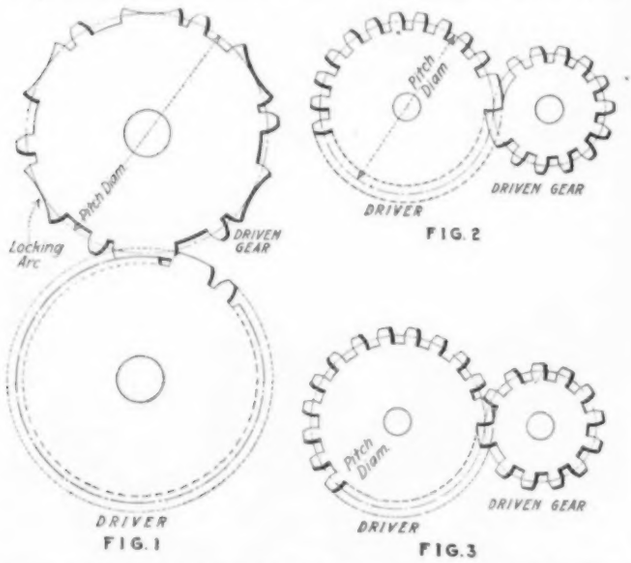
This micrometer was made in 1874 by Mr. F. W. Horstman, Sr., who at that time was employed as a foreman by the Hewes and Phillips Iron Works, Newark, N. J., with only the regular tools and appliances then in use in such a shop. While it has seen long and honorable service, it is now retired, and reposes in a cozy corner in the safe of the F. W. Horstman Co., Newark, N. J., who will be glad to show it to anyone who may be interested in its history.

Strengthening Intermittent Gears

BY S. H. YORKS

In the operation of intermittent gears the teeth that first come into mesh at the end of a period of rest of the driven gear are subject to a severe shock, and in the application of this type of gearing to certain machines this sudden contact between moving and stationary teeth causes such abnormal wear that it is important that this condition be taken into account in the design of the gears. A successful method of taking care of the difficulty is to make the teeth that receive the shock two or three times the thickness or size of the regular teeth. This can be accomplished in either one of two ways, as illustrated in Figs. 2 and 3 of the illustrations.

With the type of gearing in which the driven gear is provided with locking arcs, as shown in Fig. 1, a



FIGS. 1 TO 3. SHOCK TEETH FOR INTERMITTENT GEARS
Fig. 1—Large tooth applied to gears using locking circle. Fig. 2—Large tooth on both driving and driven gear. Fig. 3—Tooth with extra large pitch milled on each gear.

large tooth on the driver may be made by cutting the first space, then indexing for the next space without cutting, and then indexing and cutting the next two spaces. This provides the driver with a tooth having a thickness on the pitch circle three times that of the ordinary tooth. The shock on the driven gear is taken by the part of the gear forming the locking arc, which becomes in reality a large tooth. A large space is cut into the driven gear to accommodate the unusually thick tooth on the driver.

This method may also be applied to gearing of the type where the driven gear contains a full number of teeth and no locking arcs, as shown in Fig. 2. In this case a large tooth must be provided on each gear and a large space must also be provided on the driven gear to accommodate the large tooth on the driver. This space can be formed by cutting the teeth in the regular manner and afterward milling out the large tooth. The large teeth will roll on each other exactly as the ordinary teeth do.

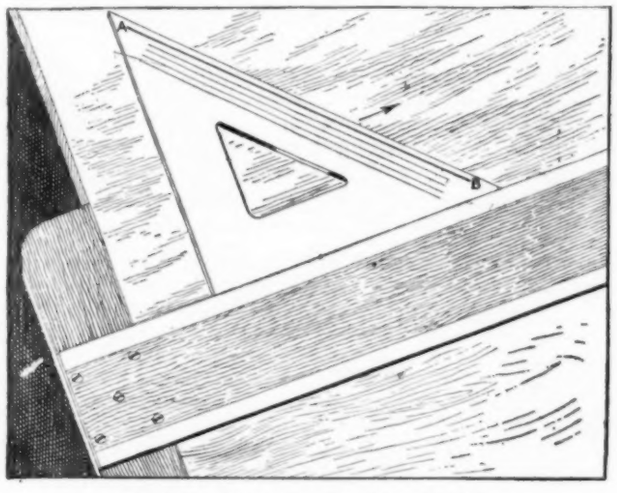
The second method of taking care of the unusual stress on gears of this type is to cut on each gear a large tooth of two or three times the pitch of the ordinary tooth and consequently of greater strength, as shown in Fig. 3. These teeth are cut on the same pitch circle as the ordinary teeth and a large space is provided on the driven gear. This type of gearing cannot be used, however, where a locking arc is employed as in Fig. 1, but is used where some other device is made to prevent the driven gear from moving during its period of rest.

Section Lining Kink

BY A. E. KIPPS

I have used the kink described below for a number of years and have found it very handy.

I scratched a line along the edge of my 45-deg. triangle, as shown at *AB* in the sketch, at a distance



EVENLY SPACED SECTION LINES

from the edge equal to the space required between the section lines.

When the first line has been drawn the triangle is moved in the direction indicated by the arrow, until the line on the triangle coincides with the first line. The second line may now be drawn, and so on.

This method insures even spacing and is also quicker than the old way.

Removal of Safety Device

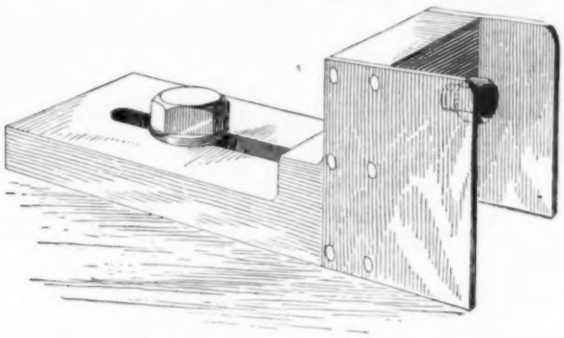
BY H. J. GUSTAV KOPSCH

On page 396 of the *American Machinist* is a letter entitled "Operator Removes Safety Device," by James Forrest, in which the author shows some exasperation at what he terms the "cussedness" of the operator.

It is of course extremely annoying to men who are to be held responsible for accidents occurring under their supervision, especially if they feel a moral responsibility as well for the safety of the workers. However, there are two sides to a problem and a safety device that involves extra work on the part of the operator, especially

if he is paid by the piece, is of doubtful value and is usually removed as soon as the supervisor's back is turned. I have found by experience that, next to safety, convenience is the main feature of protective devices and this consideration should be always in the mind of the safety engineer.

In the case of the chuck jaw shown by Mr. Forrest, why not have a jaw designed as shown in the sketch?



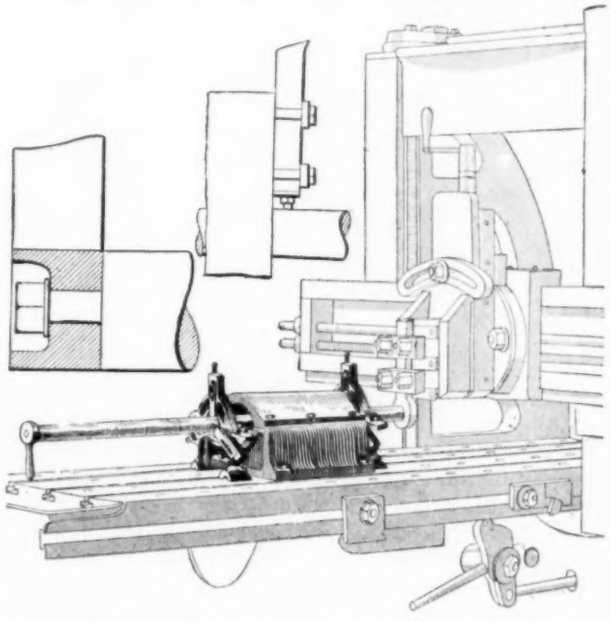
SAFEGUARDING THE CHUCK

The ribs would perform the double duty of strengthening the part and partly enclosing the screw which was the source of danger. If it is not desirable to make new jaws, why not screw pieces to each side of each jaw to project beyond the screw head? The connecting piece with the hole in it as shown by Mr. Forrest is superfluous in that it does not materially reduce the hazard and it does make the operation inconvenient.

Large Work with Improvised Tools in a Small Shop

By Miles C. Smith

The other day I was going through a small jobbing shop when a peculiar-looking device attached to one of the planing machines attracted my attention and I stopped to see what it was. Upon asking the manager-foreman who was with me what it was he answered that they were boring a large bearing that had been sent to him from one of the large shops in the city for the reason that the city shop had no lathe large enough to swing the job and it was considered too accurate work for an ordinary vertical boring mill. The cut will serve to show the equipment used and make clear the way in which the job was set up.



BORING A LARGE BEARING ON A PLANING MACHINE

The work was bolted to the table of the planing machine and a long bar was so attached to a holder held in the toolpost that the bar could be turned by means of a wrench, applied to the squared outer end. At either side of the work the bar was held from springing by a steadyrest and a casting fastened to it by two pins answered for a tool block. The entire equipment had been picked up here and there about the shop and had been fitted up for this job very easily, the only uncommon part being the device which permitted the bar to turn.

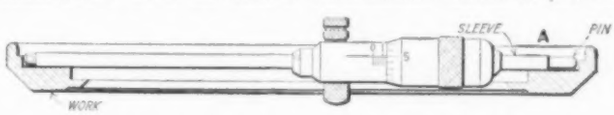
I waited until the job was ready for a cut and watched the procedure. It was very simple; in fact all there was to it was a series of light roughing cuts fed around by the operator with the wrench in hand. Then when the bore was within one-sixteenth of size the roughing tool was replaced by a radius tool ground to a radius just enough smaller than the radius of the bore to keep the corners of the tool from dragging, and I have never seen a smoother or more accurate job than was left after this tool had taken its second cut.

While this may seem a long way around to do a job, if you consider that no boring mill of any sort was available and no lathe large enough to swing the work, you may realize that the man who had taken the job and made a success of it deserved a little more credit than the fellow who sent it to him from a modernly equipped plant.

Adapter for Inside Micrometer

By Fred W. Stalker

The adapter shown in the sketch when used in connection with an inside micrometer saves a lot of



EXTENSION FOR INSIDE MICROMETER

chasing after the shop vernier, and with three pins and three sleeves permits several men to use their own "mikes" for work that ordinarily would call for the vernier.

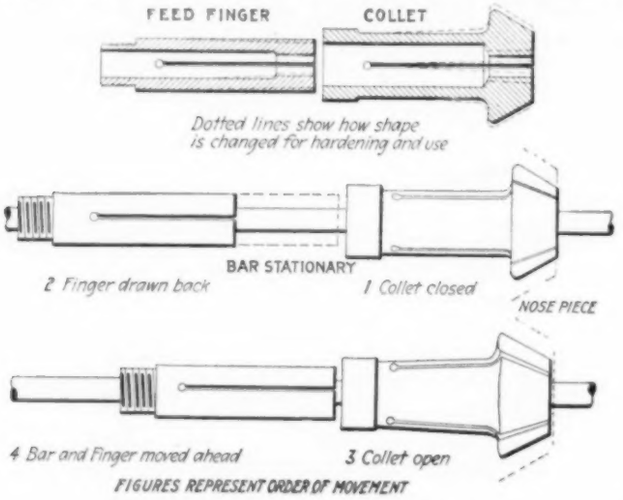
The Bar Feed on Automatics

By Donald A. Hampson

A question frequently asked by men being instructed in automatic screw machine operation is, "How does that bar feed work?" Out of sight, this movement cannot be traced while running as can others whose parts are exposed. It is therefore not surprising that the apparent self-movement of the bar excites interest.

An excellent simile of the feeding principle is presented by grasping a bar of steel in both hands and going through a few simple movements. Let the only movement of the left hand and arm be the opening and closing of the fingers. When they are open, shove the bar forward with the right hand and arm. Close the left hand on the bar with a tighter grip

than the other hand so the bar will stay in place, then draw the right hand back along the bar to the original position. That is the entire cycle of movements. In the screw machine, the left hand is represented by the collet. Its duty is to drive the bar during the working period just as it would be driven by a universal chuck. When the collet is released, it opens sufficiently to allow the bar to be moved through it without hindrance. The collet is released only long enough for the feeding to take place. The feed finger or shell corresponds to the right hand. It grips the bar hard enough to move it against the resistance imposed by weight and friction but not hard enough to move it when the collet closes. Thus the feed finger may be drawn back over the bar at any time during the cutting operations, setting itself in readiness for the next stock feed when the collet opens. The feed finger must remain stationary until the collet has



DETAILS OF FEED MOVEMENT

closed or the bar would be drawn back into the spindle and the feed be short. Advantage is taken of the finger slipping to always insure a full length of blank. The speed of the machine, chips or a crook in the bar may cause the feed finger to slip a little on the forward stroke, resulting in a short piece if the feed were set exactly the length of the piece, but by setting the machine to overfeed and letting the finger slip when the bar strikes the stop, a full length is insured.

Tubes, passing through the spindle to the visible cams and forks at the end of the machine, control the movements of the collet and feed shell to any desired camming. The collet is practically stationary in a longitudinal direction, a sixteenth of movement or less being ample for its release; its own "spring" and the taper of the nose end cause it to open. Return of the feed finger is always through a cam movement while the forward, or stock feeding, may be either by cam or the action of a coil spring.

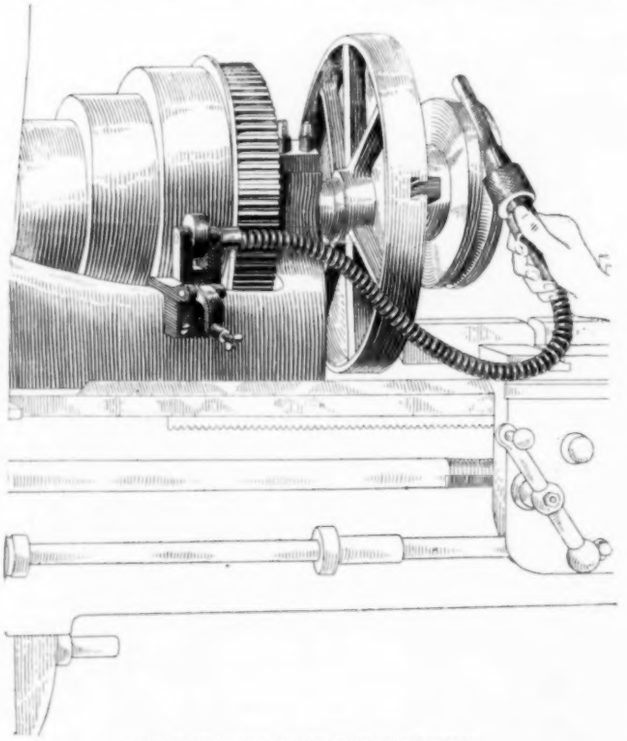
Hand screw machines feed in much the same way. The chief difference is in the movement of the bar which is often moved by hand, the operator reaching toward the end of the machine and grasping it after the collet is opened and drawing it forward against the stop. The collet action on the hand machine is identical in results with that of the automatic but a conveniently located hand lever takes the place of the cam-operated parts.

The collet and feed finger for any size of bar are made up with straight holes of the same size as the bar. These are then split and the collet is spread open while the feed finger is closed. In this condition they are hardened, producing a collet that in its natural shape allows the bar to pass through very freely and a feed finger that is a tight push fit on the bar. Upon the accuracy with which these parts are made and the nicety of hardening depends the smooth working of the machine; lack of concentricity is responsible for short feeding; anything but glass hard-working surfaces cause sticking of the collet and early wear in both collet and feed finger; too soft a spring temper in either piece means erratic feeding, the only cure for which is rehardening. Except for variations of about a sixty-fourth, separate collets and feed fingers are required for each size and shape of stock. Master collets and shells are used on larger machines with bushings or pads for the different-sized bars. The drawing shows the parts in various positions.

Lapping Grooved Rolls

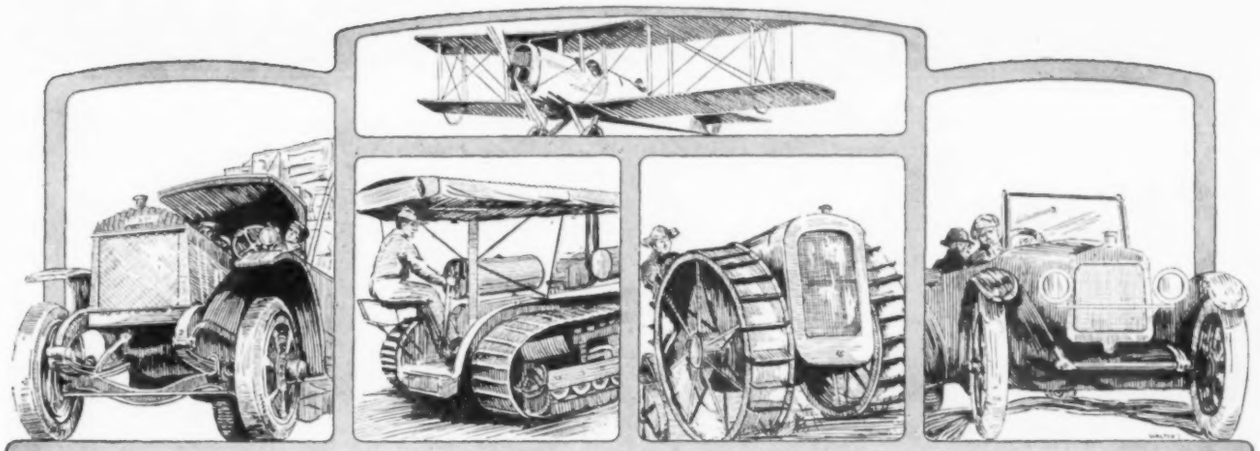
BY S. B. ROYAL

Hardened-steel rolls with round grooves are used for many purposes particularly in wire feeding and straightening devices. The grooves soon wear out of shape, becoming too deep or too wide, and grinding or



METHOD OF LAPPING GROOVES

lapping with a stationary lap not only presents difficulties but does not always give satisfactory results. If instead, they are lapped by means of a lapping rod of the required diameter on the end of the flexible shaft as shown in the cut, perfect results will be attained. The method of operation is obvious. The roll, mounted on an arbor, is run at a high speed and a soft copper or brass rod is used with emery or diamond dust and oil. Besides securing a better job, the saving in time will be considerable.



AUTOMOTIVE CONSTRUCTION

Machining a Six-Cylinder Motor—I

By J. V. HUNTER
Western Editor *American Machinist*

Automobiles equipped with six-cylinder motors are constantly increasing in popularity, and the machining operations necessary in the production of such motors represent the latest refinements in efficient shop practice in maintaining a high quality of output which is being secured at a minimum cost of production.

AMONG the well-known manufacturers of the six-cylinder automobile motor the Falls Motor Corporation of Sheboygan Falls, Wis., has specialized in six-cylinder motors of one size. In the motor under consideration the cylinder block is cast in one piece with the upper half of the crank case. The first of the major operations on this part is performed on the milling machine shown in Figs. 1 and 2, and at this setup the top and bottom and one side are milled complete. The details of the fixture used for this operation are more clearly shown in Fig. 2. The fixture is substantially made and has machined stops *A*, on which the cylinder block rests. The block is clamped into position by means of a holding-down bar *B*, and adjustable stops *C* insure a full pressure on all parts of the casting. Large milling cutters with inserted high-speed cutters are used.

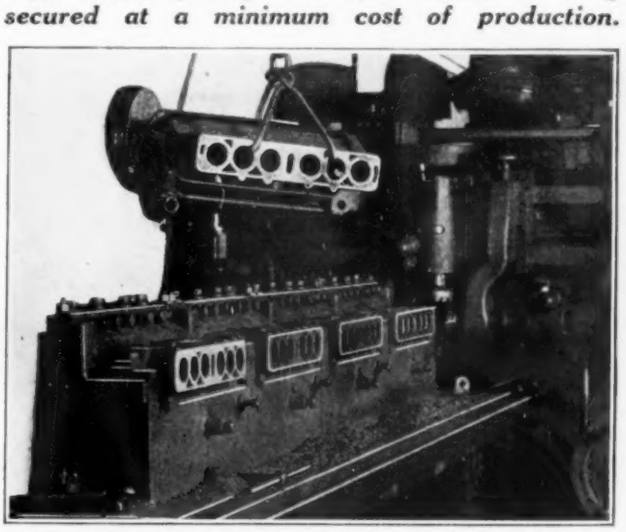


FIG. 1. MILLING ENDS AND ONE SIDE OF MOTOR BODY

Four holding fixtures are carried on the machine table, permitting the operator to remove and insert fresh castings in some of the fixtures while the machine is taking a cut on the others. In Fig. 1 one of the cylinder blocks is shown suspended over the table, indicating the method by which they are handled to and from the milling fixture. At the rear of the machine the operator removes the finished blocks from the first fixture while the machine is making its cut on the last block of the series.

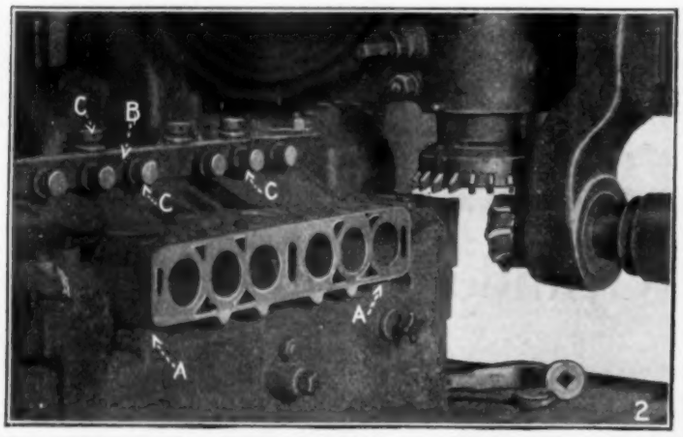
The blocks are then placed on a second milling machine, Fig. 3, where the two ends are milled, using a fixture somewhat similar to those employed in the first milling operation, with the exception that it has permanent stops which contact with the surfaces already machined. This machine carries six fixtures on its table, and the machined blocks at one end are being removed while the cut is working on the remainder. It is the practice of this shop to use a milling-machine cutting speed on cast iron of about 120 ft. per minute with a feed of 12 in. per minute. When it is necessary to vary the cutting speed of the machine the feed is varied in direct proportion, that a ratio of 10 ft. of cutitng speed to 1 in. of feed is maintained. A similar practice is followed in operations on aluminum castings, with a ratio of $\frac{1}{2}$ in. of feed to 10 ft. of cutting speed. On aluminum it is not permitted to use a cutting speed of less than 325 ft. per minute, and from this it is occasionally increased to a maximum of 900 ft. per minute. The maximum cutting speeds are used when a highly finished surface is desired.

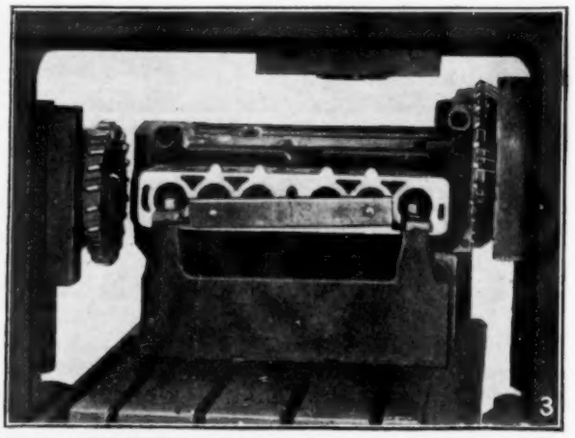
For boring the cylinders the block is mounted on a special vertical cylinder-boring machine, built by the Foote-Burt Co., arranged to bore all six cylinders simultaneously. In this operation 0.015 in. is left for the finish-grinding operation.

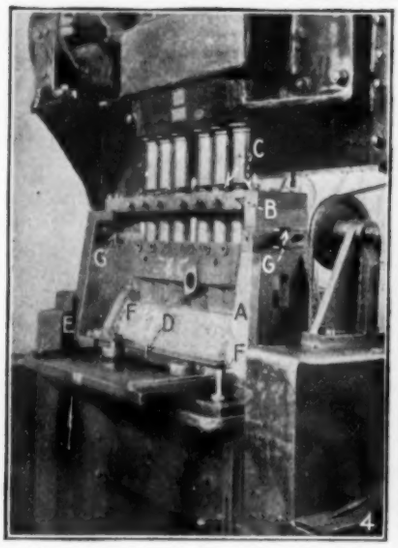
AUTOMOTIVE CONSTRUCTION

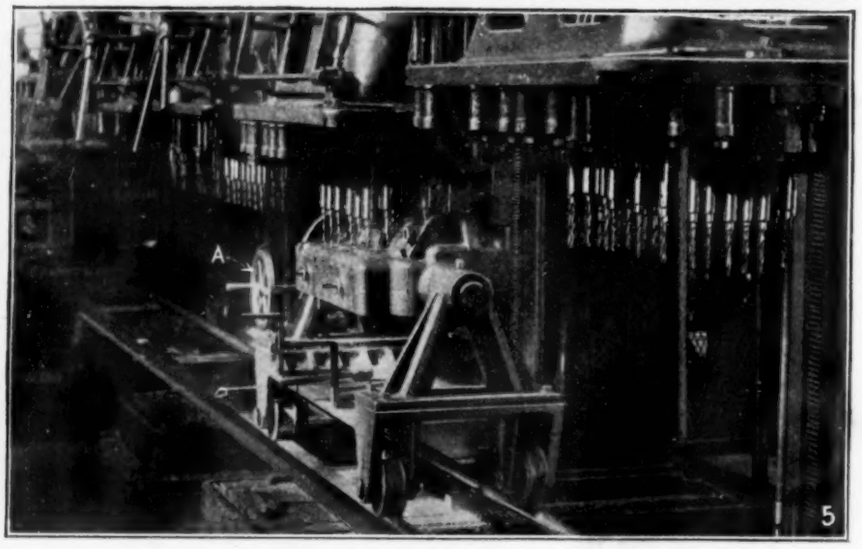
The fixture consists of a heavy frame *A*, Fig. 4, which has a top guide plate *B* with bushings *C* for steadying the boring bars. The cylinder block is placed on the plate *D*, which slides on the ways *E*, which are a part of the baseplate of the fixture. This table is drawn forward on the ways to permit placing the block in position, and the block is guided into place by stops which fit against the surfaces previously milled. When the loaded table is pushed back into position for boring, stop pins *F* pass through the lugs in the table into the baseplate and hold it securely. Additional security during the boring operation is provided by means of the clamps *G*, on top of the cylinder block.

Grinding of the bore of the cylinders is done dry on a battery of Heald internal grinding machines in which two roughing cuts and one finishing cut are taken.









FIGS. 2 TO 5. MILLING AND DRILLING OPERATIONS

Fig. 2—Fixture and clamping methods for milling motor. Fig. 3—Milling both ends of motor. Fig. 4—Fixture and machine for boring six cylinders. Fig. 5—Drilling all sides of motor body in sequence of operations.

Multiple Drilling

For drilling, five 72-spindle Natco drilling machines, Fig. 5, are arranged so as to permit drilling approximately 290 holes in the cylinder block at one setting of the work. The drilling machines are placed in a line, and a track laid across their beds, one of the rails being a T-rail and the other a piece of 2-in. cold-rolled shafting.

The first four drilling machines are handled by a single operator, and their output is 15 cylinder blocks per hour. The fifth machine of the series, which has a different set of operations to perform, is handled by another workman. The cylinder block is mounted in the revolving and indexing jig which runs on the rails referred to, and is pushed into position under the first machine of the series. Here it is indexed by a suitable stop, and this machine drills all the holes in one side.

From the first machine it is successively pushed along to the other three machines of the series, and between each machine it is indexed 90 deg. to present a different side to the drills, and when its trip is completed all four sides have been drilled. At the far end of the line the block is removed from the fixture and is ready for end drilling under the fifth machine of the series.

Another view of the fixture, Fig. 6, shows how the base *A* is ribbed both above and below to give it additional stiffness. The revolving body *B*, supported by

AUTOMOTIVE CONSTRUCTION

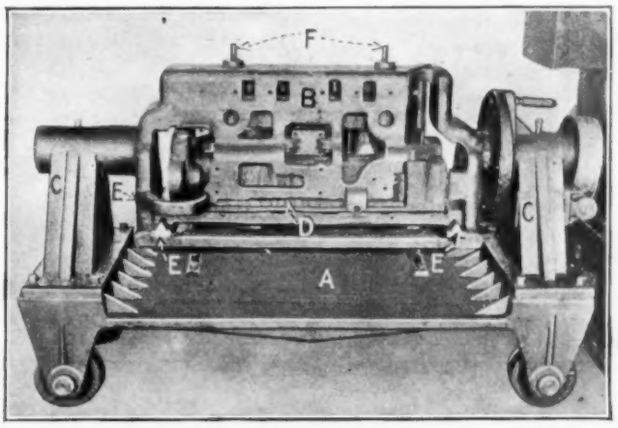


FIG. 6. REAR SIDE OF SPECIAL DRILLING FIXTURE

means of the uprights *C* is provided with a sliding bottom plate *D* which can be pulled in and out on the Vs *E* in a manner similar to the baseplate used in the fixture of the cylinder-boring machine.

When the block has been set on the baseplate *D* and slid into place it is securely clamped into position by means of the screws *F*. The secure manner of clamping by these screws permits the jig to be revolved without any danger of movement which would tend to get the holes on any one side out of place. The fixture is revolved by worm gearing turned by the handwheel *A*,

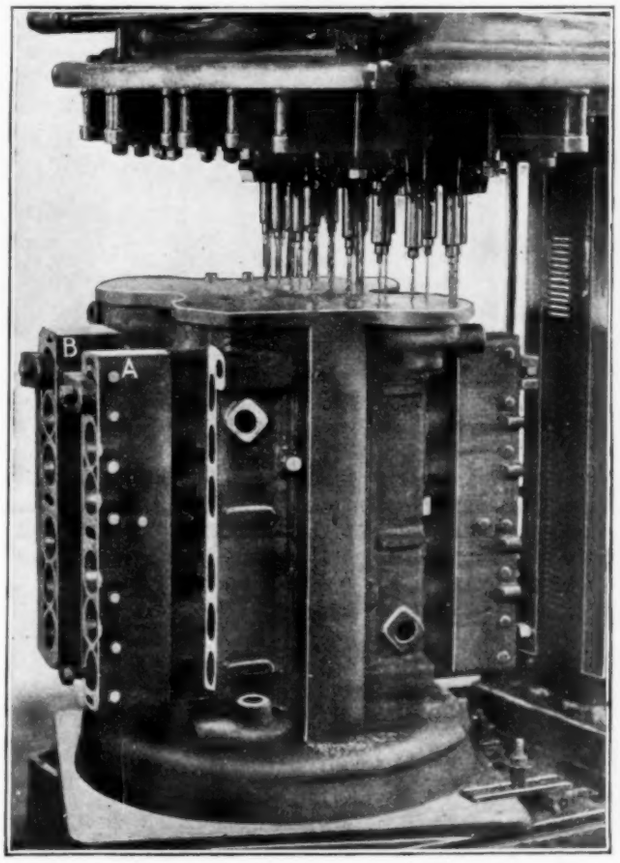


FIG. 7. INDEXING JIG FOR DRILLING MOTORS IN PAIRS

Fig. 5, until the indexing pin comes into place in each position.

For drilling the end holes the cylinder blocks are mounted in the drilling fixture, Fig. 7, which holds four cylinder blocks at one time, two of these being drilled while the other two are being dismounted and others mounted ready for drilling. This fixture is so made that the cylinders are drilled in pairs, and at each operation one cylinder block is drilled on its gear-case end and the other on the flywheel end. These are shown mounted at *A* and *B*, and when they have passed beneath

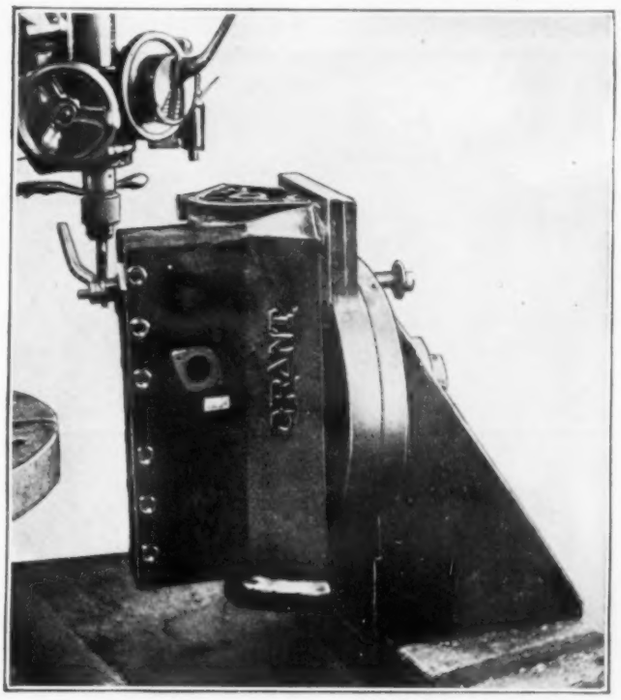


FIG. 8. FIXTURE FOR TAPPING HOLES IN BODY

the drills they are removed and turned upside down and reversed in position in the fixture so that the other ends will be drilled. The fixture has an indexing device providing for a complete half turn at each operation.

After drilling the cylinder block, a number of holes are tapped under a reversible radial drilling machine, Fig. 8, which is equipped with a special revolving fixture for swinging the cylinder block into the required positions. This fixture will be understood from the illustration, which shows that it is provided with a large and massive circular plate and center bearing and may be indexed to the correct positions so that the tap will always enter the holes in correct alignment.

Building a 30-Hp. Tractor

BY B. CALDWELL

The illustrations give a picture story of the progressive assembly of the Hart-Parr 30-hp. tractor, in their shop at Charles City, Iowa, showing its progress from the beginning of the frame assembly in Fig. 1 to the completed machine. As will be seen the frame consists of a steel casting to which are bolted two channel irons which form the front end. The main

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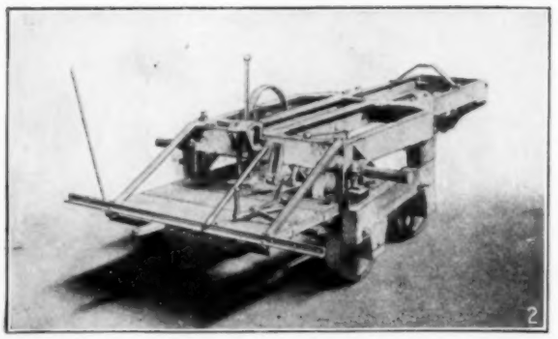
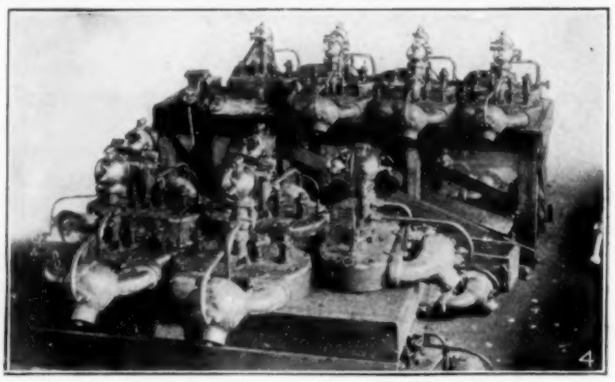
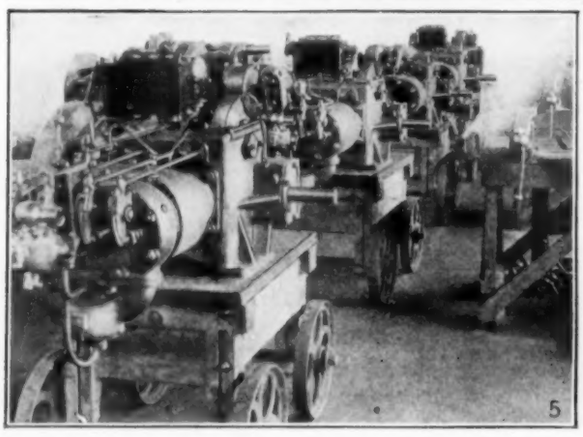






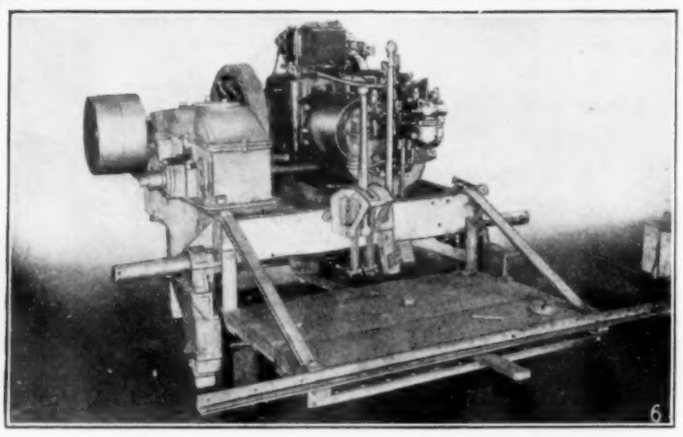
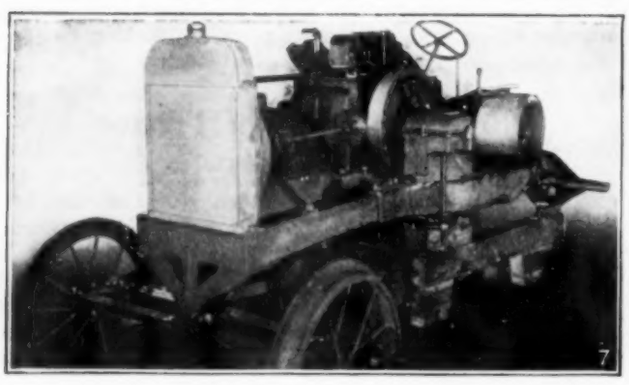
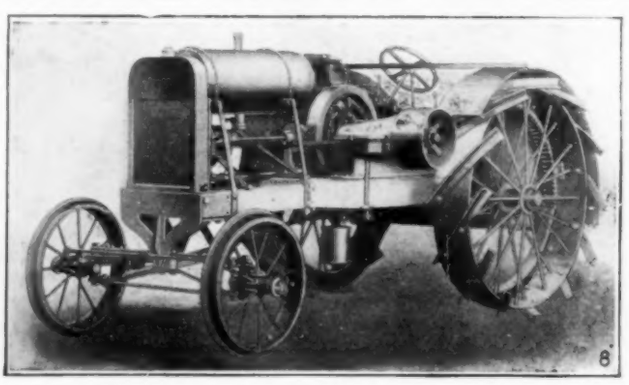


FIG. 1. THE CAST STEEL FRAME
FIG. 2. REAR PLATFORM IN PLACE
FIG. 3. ASSEMBLING TRUCK USED
FIG. 4. CYLINDER-HEAD ASSEMBLY
FIG. 5. MOTORS READY TO MOUNT
FIG. 2. MOTORS IN PLACE
FIG. 7. FRONT AXLE IN PLACE
FIG. 8. THE COMPLETE TRACTOR





axle bearings are babbitted on the mandrel shown, which is 2¼ in. in diameter.

The next stage, Fig. 2, shows the rear platform bolted in place, the axle in position and the front end ready to receive the steering wheels. This assembly takes place on the small four-wheel truck which carries the body until it is ready to go on its own wheels.

FINISHING THE ASSEMBLY

The driving gears and jackshaft are shown in place in Fig. 3, which also gives a better view of the supported truck. The motor is a two-cylinder, four-cycle, with a removable head carrying the valves. Some of these heads are shown in unit assembly in Fig. 4. The cylinder is 6½-in. bore by 7-in. stroke and runs with 70-lb. compression. The normal speed is 750 r.p.m., the speed being controlled by a centrifugal governor. The assembled engines are shown in Fig. 5, also mounted on trucks and ready to be put in position on the tractor frame, as shown in Fig. 6, which begins to assume the appearance of a completed tractor.

The last stages of the assembly is putting the wheels in place, Fig. 7 showing the front pair in position with the rear end supported on the truck. The completed tractor is shown in Fig. 8 with its driving wheels in position, the kerosene tank in place and the machine ready to run.

Multi-Bladed Airplane Propellers

Experiments in airplane-propeller design are being made to show the advantages of the different types. Airplane designers however are apparently overlooking the important question of the relation between airplane efficiency and the number of propeller blades. There is unfortunately no conclusive data at hand, regarding the relative merits of the three- and four-bladed propellers. For training work and all ordinary work two blades are usually preferred. For expert flying, and for high-powered machines in which there is a restricted diameter of propeller in proportion to power applied, three and four blades are giving better performances. There are numerous instances where the three-bladed screw, even though it has less diameter, shows marked superiority over the two-bladed propeller. The three-bladed propeller is also noted for its peculiar jointing and fitting together of the ends of the laminations where they form the hub.

This hub is trebly laminated over its entire area with the material so disposed as to direction of grain, etc., that it makes without doubt the strongest hub that can be built in any propellers.

Lawrence Airplane Motor

The Lawrence 3-cylinder air-cooled airplane motor designed for use on the sport-type machines develops 52.5 hp. at 1600 r.p.m., has a bore of 4.25 in. and a stroke of 5.25 in. The cylinders, placed 120 deg. apart, are aluminum castings with air-cooling fins machined on them and are fitted with $\frac{1}{16}$-in. case-hardened steel liners. The valve seats are made from bronze having the advantage of requiring infrequent grinding, while the aluminum and bronze have nearly the same expansion coefficient. An interesting feature of the engine is the valve spring, this being made of a flat ribbon of steel. The steel ribbon is tapered and rolled into a spiral so that the wide part of the ribbon forms the outer coils. This gives the valve springs a very low over-all length and all coils are stressed equally. The weight of the motor with magneto and carburetor is 132 lb.

Aërial Transportation Corporation Recommended

Alan R. Hawley, president of the Aëro Club of America, recently addressed the National Rivers and Harbors Congress held in Washington, D. C., to solve the problems regarding the disposal of the Army and Navy equipment approximating $1,000,000,000,000, and the employment of the 28,000 pilots and 300,000 men discharged by the Army and Navy Air Service. He recommended the organization of an Aërial Transportation Corporation, owned by the Government and capitalized at $50,000,000. This organization is to take over this $1,000,000,000,000 worth of airplanes, motors and aëronautic equipment which the Army and Navy cannot use and are trying to dispose of. The officials of this corporation are to devise ways and means for salvaging this equipment, utilizing whatever can be used to establish aërial transportation lines in the United States and supplying the South and Central American countries which are anxious to have aërial transportation lines. The abandoned Army aviation stations and depots shall be operated by the corporation as public aërodromes where civilian aviators may use the hangars and facilities by paying rent. This corporation shall establish and operate aërial transportation lines between industrial centers. All air traffic should be classed with interstate and international traffic and the interstate traffic regulations should be extended to include air traffic.

Japanese Motor-Vehicle Subsidy

A military motor-vehicle subsidy law has been passed recently by the Japanese Diet, which provides subsidies for manufacturers and owners of motor vehicles suitable for military use, capable of carrying one ton. The vehicle may be requisitioned at any time for reasonable compensation. The law provides that the manufacturers and owners must be Japanese subjects and vehicles must be of Japanese origin. Pending greater production of Japanese vehicles, however, owners of cars of foreign manufacture are allowed within the subsidy scheme.

New Waterproof Propeller Coating

The Forest Products Laboratory at Madison, Wis., has developed a waterproof coating for air propellers. By the application of this new coating, the propeller surfaces are practically covered with a plating of a thin aluminum leaf in the finish, to protect the airscrew from the absorption of water. Propellers finished with the coating have been found very satisfactory in the Government tests, particularly in the storage stage.

Prices, Yesterday, Today and Tomorrow*

By O. P. AUSTIN

THE purpose of this address, as implied by its title, "Prices, Yesterday, Today and Tomorrow," is an attempt to look into the future and determine, if possible, the probability as to the course of prices. That there have been great and continuous advances during the war period we are painfully conscious, and in the five months since the cessation of hositilities we have failed to experience the reduction which some had fondly hoped would come with the close of the war. In a few instances there have been slight reductions, but in others there are still advances, and the index figures on foodstuffs in New York today are actually higher than those on Nov. 5, when the whole world so joyously welcomed the apparent termination of the great conflict which had raged for fifty-one months.

Since 1918, paper money with a face value of $36,000,000,000 has been issued by the countries engaged in the late war. This amount is greater than the value of all the gold and all the silver mined in the world since the discovery of America. In the four years of the war the national debts of the world have increased from $40,000,000,000 to $220,000,000,000 and the annual interest charge, from $1,750,000,000 to $10,500,000,000 or more than fivefold. In the meantime most of the gold formerly in circulation has been locked up in governmental vaults. These conditions constitute an inflation of currency greater than ever known and it would seem impossible that commodity prices should be much reduced until some progress is made in deflation.

To attempt to determine what is likely to happen in the future we must try to find the cause of the things which have happened in the past, and also to see whether this cause is or is not likely to continue in the near future. When prices began to advance in the opening of the war, we could readily see that the upward movement was due to the urgent demand for the food and raw material required by the enormous armies which had been put into the field, and this cause has been designated the "scarcity demand," but when we found the advance extending to many articles in which there was no scarcity and which were not used by the armies or utilized in the manufacture of their requirements, we began to realize that a part of the advance must be due to some cause other than mere war or scarcity demands.

Edgar Crammond, the distinguished British statistician and economist, in an address before the London Institute of Bankers on Mar. 26, 1919, stated that the three facts which would tend to make the fall in prices a very gradual one are: (1) The vast increase in the amount of paper money; (2) the huge increase in the amounts of public debts of the belligerents; (3) the determination of labor to maintain wages and improve the standard of living.

Price Advances Were World-Wide

Raw silk, for example, for which the war made no special demand and which was produced on the side of the globe opposite that in which the hostilities were occurring advanced from $3 per pound in the country of production in 1913 to $4.50 per pound in 1917, and over $6 per pound in the closing months of the war. Manila hemp, also produced on the opposite side of the globe and not a war requirement, advanced in the country of production from $180 per ton in 1915 to $437 per ton in 1918. Mechanically ground wood pulp, not a war requirements, advanced, as our publishers are aware, from $14 per ton in the opening months of the war to $35 per ton in the opening months of 1916, and the grade known as "chemical bleached" advanced from $50 per ton at the beginning of the war to $100 per ton in January, 1919. Goat skins, from China, India, Mexico and South America advanced from 25c. per pound in 1914 to over 50c. per pound in 1918 and yet goat skins were in no sense a special requirement of the war. Pig tin produced by Chinese labor in the Malayan Peninsula and the Dutch East Indies and not to a very great extent a war requirement sold in the country of production in 1914 at 30c. per pound and in the same markets at 75c. per pound in the closing weeks of the war. Sisal grass, produced in Yucatan, advanced from $100 per ton in 1914 at the place of production to nearly $400 per ton in 1918, and Egyptian cotton, a high-priced product and thus not used for war purposes, jumped from 14c. per pound in Egypt in 1914 to 35c. per pound in 1918. Even the product of the diamond mines of South Africa advanced from 60 to 100 per cent. in price per karat when compared with prices existing in the opening months of the war.

The prices which I have quoted to you are in all cases those *in the markets of the country in which the articles were produced* and in most cases at points on the globe far distant from that in which the war was being waged. They are the product of countries having a plentiful supply of cheap labor and upon which there has been no demand for men for service in the war. The advance in the prices quoted is in no sense due to the high cost of ocean transportation since they are those demanded and obtained in the markets of the country of production.

All Classes of Producers Affected

Why is it that the product of the labor of women and children who care for silk worms in China and Japan, of the Filipino laborer who produces the Manila hemp, the Egyptian fellah who grows the high-grade cotton, the native workman in the diamond mines of South Africa, the Mexican peon in the sisal field of Yucatan, the Chinese coolie in the tin mines of Malaya, or the goat-herd on the plains of China, India, Mexico or South America has doubled in price during the war period? The articles enumerated were in no case for use in the war and the prices are those in the country of production and thus not due to the increase in ocean freights or dangers of oversea transportation. The advance has been general, world-wide. In a few articles in which an overproduction was occurring in which the demand fell below normal the advance was not so strongly marked, but there is scarcely an article in the long list of those entering world markets in which there has not been an advance, no matter how distant its place of production from that in which the war was occurring, or how little the war's demands for it, or for the labor by which it was produced.

Great Underlying Causes of World Advances

Surely there must have been some general underlying causes for this world advance, this simultaneous demand by people of all classes and in all parts of the globe for higher prices for their products irrespective of their relation to war requirements. While we may be willing to accept the immediate demands of the war as a part explanation of the advance in the prices of foodstuffs and certain manufacturing material and manufactures we must look farther for the cause of the similar advance in articles upon which the demands of the war could have no direct bearing. It is true that a marked advance in the price of one important class of product does cause an advance in

*From an address before the Editorial Conference of the New York Business Publishers' Association, in New York City, April 11, 1919.

the prices demanded for other articles which must be exchanged for those in which the advance has already occurred, but it does not seem probable that the advance due to scarcity of a comparatively few of the world products required for war could have been the chief cause of the doubling of prices in practically every article produced in every part of the world, many of which had not the most remote relation to war requirements.

Principal Causes of Advance in Prices

Apparently the principal causes of the advance in prices during the war were, stated in their chronological order, first, "scarcity demand"; second, the advance in wages presumably due to the increased cost of living and demand for labor, and, third, the large increase in world circulating media; or to put it in a single world "inflation." Prof. A. C. Miller, member of the Federal Reserve Board, an authority whose views are entitled to high consideration, in a recent address before the American Academy of Political and Social Science named as the two chief causes of the advance in prices, "scarcity demand" and "inflation," adding that "there is so much evidence of an artificial abundance of money in comparison with the things that are purchasable by it that the abundance of money must be credited *with at least* an equal influence in explaining the high prices which have prevailed."

The "Scarcity Demand"

What were the articles for which the war created a "scarcity demand?" Food, clothing, transportation facilities, and material for the battlefield. How much did it add to the world's demand for these articles? Of course, the percentage of increase in demand for strictly war materials was very large, but was there really as great an increase in demand for other materials, food, clothing, and transportation facilities as we are accustomed to imagine? Let us assume that the number of people participating in the war was forty million, which is probably more than those in the field at any one time. Do we realize how small a share those forty million were of the world's consuming population? Less than two and one-half per cent. We think of forty million as a large number of people to feed, and so it is, but it must be remembered that the number of people in the world who must be fed and clothed and supplied with transportation facilities every day of the year is 1,800,000,000 or forty-five times as many as the highest number in the military service at any time during the war. Of course the soldiers were better fed than are many of the people in certain sections of the world, but even if their per capita consumption was four times as much as the average it would still represent but a small percentage of the world's daily food consumption. And it must be further remembered that all these forty million people in the armies had been consumers of food before the beginning of the war, not to quite as great an extent perhaps as after entering the activities of the military service, but it cannot be assumed that the war added forty millions to the world's consumers of food and clothing. Nor can it be properly assumed that the withdrawal of these millions from the industries actually reduced to that extent the world's producing power, for four millions of these were already in the military service and the places of the other thirty-six million were to a considerable degree filled by others who had not been up to that time actively engaged as producers.

Supplies "Switched" from Usual Lines of Industry

Much of the material used in preparing the supplies for the battlefield was "switched" from the usual lines of industry, for there was an immediate cessation of railway construction, building operation, and a thousand industries which formerly required manufacturing material, and as a result of this cessation of activities the material formerly used by them became available for war purposes.

It thus appears on close analysis that the "scarcity demand" created by the war was not as great in food, clothing, or manufacturing materials as has been pictured, while the fact that fifteen millions are still under arms minimizes the reduction in military demands which had been expected.

One factor often mentioned in the attempt to determine the causes of high prices is the advance in wages of labor, but the fact that the increase in compensation of labor was in most cases given because of the fact that the cost of living had already advanced at least somewhat minimizes the relative importance of this factor in attempting to discover the real causes of the general world-wide advance in prices. And it must also be remembered that several million persons who had not been engaged in the industrial and business world came to the assistance of those engaged in these duties during the war.

Increase In World Currency—"Inflation"

Where then shall we turn in the search for the principal cause of the general advance in prices of articles produced the world over and their relation to the demands of the war? What other cause can we find after giving due consideration to the "scarcity demand," the destruction by war and the increased cost of labor? The most prominent among the possible or probable causes is the theory advanced or accepted by the historians, economists, statisticians and financiers of the world that inflation in currency is usually accompanied or closely followed by an advance in prices; and, as already indicated, so high an authority as a member of the present Federal Reserve Board, Prof. A. C. Miller, has recently declared that "the abundance of money must be credited with at least an equal influence in explaining the high prices which have prevailed."

I wonder if we do fully realize the quantity of paper money which the responsible governments of the world have put afloat since the beginning of the war—thirty-six billion dollars. The paper money in existence in the fifteen principal countries of the world at the beginning of the war was less than eight billion dollars and at the end of the war was over forty-four billions, an increase of thirty-six billions in fifty-one months, and this does not include any of the eighty billion dollars worth of paper currency issued by the Bolsheviki in the eighteen months of their control in Russia. Thitry-six billion dollars of new paper money added to the circulation of the world by fifteen responsible governments in a little over four years of time!

Thirty-Six Billion Dollars Worth of Paper Promises

We had been inclined to charge up the advance in prices occurring prior to the war to the fact that eight billion dollars worth of gold was turned out by the mines of the world in the twenty years following our famous gold and silver campaign of 1896. But here are thirty-six billion dollars worth of paper promises to pay turned out as legal tender money by fifteen responsible governments in a short four-year period.

Do we realize how vast a sum is this thirty-six billion dollars worth of paper currency which has thus been put into circulation in such a brief time? It is more, *in its face value*, than all the gold and all the silver turned out by all the mines of all the world in the 427 years since the discovery of America.

True, much of this paper money is now more or less depreciated in its value as compared with gold, the world's accepted standard, but the fact that it has behind it not only a certain amount of the yellow meal but also the pledge of the governments by whose authority it was issued renders it as least an accepted medium of exchange in the countries of its origin, while the fact that nearly every neutral country of the world has meantime increased its paper currency and national indebtedness, permitting its gold to pass from circulation into the vaults of its banks as a security for the paper circulation, tends to widen the field affected by this inflated currency.

Increase in Other Governmental Obligations

In addition to these vast sums of legal tender currency turned out by fifteen responsible governments of the world, these same governments have at the same time made an even more spectacular advance in their issue of another series of promises to pay, which, while not legal tende

in the ordinary sense of the term, do form a more slowly moving mass of currency. By this I mean the one hundred and eighty billion dollars worth of bonds or other forms of national obligations issued by the governments of the world in the past four years, for national debts of the world have advanced from forty billion dollars at the beginning of the war to two hundred and twenty billions at its close. And while these bonds or other governmental promises to pay money at some future date are not legal tender currency in the ordinary sense of the term they do pass current in the financial world and prove a basis upon which money may be readily obtained by their holders, and to this extent are an addition to the world's circulating medium.

Bank Deposits Greatly Increased

Still another increase in circulating media is found in the enormous growth in bank deposits, which of itself increases circulation through the increased use of checks, especially in countries such as the United States where the check forms so large a share of the daily business transactions of the country. Bank deposits in fifteen principal countries of the world have grown from twenty-seven billion dollars in 1913 to approximately seventy-five billions at the present time, the ratio of increase being about the same as that of currency.

These increases in circulation, indebtedness and bank deposits, while occurring chiefly in the countries participating in the war have also extended to many other countries, especially in Europe, where the six principal neutrals have during the war period increased their national debts one billion dollars, their note circulation over a billion dollars and their bank deposits by about one billion.

Thus in a short four and one-half year period world paper money has increased thirty-six billion dollars, world evidences of national indebtedness one hundred and eighty billion dollars and world bank deposits nearly fifty billion dollars. Most of this enormous increase has occurred in "uncovered" paper. The gold mines of the world have turned out less than two billion dollars worth of the precious metal during the war period and most of the world's gold, which formed fifty-five per cent. of world circulation at the beginning of the war, has passed into the vaults of the governments of their great banks as a basis for their paper currency, and now bears a relation of but about twenty per cent. to the flood of paper money in circulation, and this proportion of gold to paper varies widely when the respective countries are compared.

Inflation and High Prices

If the world's historians and financiers and economists and statisticians are right in their general belief that an advance in prices usually accompanies or closely follows inflation in currency, and especially in paper currency, can we be surprised at the world-wide advance in prices which we have witnessed during the past four years in which world currency and bank deposits trebled and national debts quintupled?

Prices of Tomorrow

We come now to the third and final question, that of prices of tomorrow. May we expect a material reduction in general prices in the near future? And in trying to determine this we must see whether the causes which brought about the advance during the period are likely to be removed.

The chief causes of the advance seem to have been the "scarcity demand," the higher cost of labor, and the increase in circulating media.

Will the "Scarcity Demand" Terminate?

The "scarcity demand" came on the very first day of the war, for most of the countries entering the struggle found that the demand upon them would be far in excess of their supplies either of foodstuffs or military requirements and as the weeks and months and years progressed this fact was more strongly impressed upon them.

During the closing year of the war the ammunition factories of the various participating countries were able to meet to a great extent the requirements of their own armies but in the matter of foodstuffs the "scarcity demand" still continues with little prospect of abatement at least in the near future. The number of mouths to feed in Europe has not decreased and that continent, which has not for many years been able to produce its own requirements of foodstuffs, now finds itself with neglected soils, a disordered population and unable to return to normal production in the immediate future. In manufacturing materials, for which Europe has also been dependent upon other parts of the world, she will require abnormally large quantites at least in proportion to her attempts to manufacture, for her stocks of this class of merchandise are absolutely exhausted. In all parts of the world which have relied upon Europe and the United States for manufactures the shelves are empty and must be filled and most of the manufacturing sections of Europe will evidently be slow in resuming the production of manufactures for exportation, and will have limited facilities for transporting or marketing them even if produced. So it seems that, although the demand for war material has terminated, the other features of the "scarcity demand" will continue at least in a somewhat modified form in the immediate future, especially as relates to world requirements of food, manufacturing material and manufactures, while developments thus far do not point to an early reduction in labor costs.

Will the Over-Supply of Currency Be Reduced?

If we are right in assuming that a considerable proportion of the world advance in prices is due to the enormous increase in world currency can we expect a marked reduction in prices until the cause, "inflation," is removed? Or, to put it in another form, that part of the advance caused by inflation can only be cured by deflation, by a reduction in the enormous stocks of currency which, as I have shown you have trebled during the war, while that other form of slowly moving currency, governmental obligations, has quintupled.

Is it probable that these two forms of currency can be or at least will be reduced in the near future? The governments of the world, which were paying less than two billion dollars a year of interest on national debts at the beginning of the war are now paying and must continue to pay a total of over ten billion dollars a year in interest, and at the same time all other expenses of governments have advanced. Official estimates of the "budgets" or expense accounts of several of the principal countries for the coming fiscal year have already been announced and indicate that their necessary expenses in the first full year of after-war peace will be about four times as great as in the year preceding the war. The British budget for next fiscal year is estimated at about six times as much as in 1913 and those of France, United States and Canada about four times as much as before the war. Present indications are that the governments of the world will be compelled to collect in taxes from their people about fifty billion dollars a year as against about twelve and one-half billions in 1913, or say a billion dollars a week as against a billion dollars a month before the war, *and* this does not include anything for "sinking funds" or other provision for reduction of outstanding debts. If this be true is it probable that the governments in those countries which have greatly increased their circulation and must now demand such enormous increases in annual payment of taxes will find it advisable or possible to materially reduce the amounts of currency available for such payments?

Are We Justified in Expecting a Reduction in Prices?

If the governments which have been the chief participants in the world increase of currency should fail to materially reduce that excessive supply, and if the world's demand for food, manufacturing material and manufactures is to continue at the present rate, are we justified in expecting a general reduction in prices in the near future? The question I think answers itself. There will, of course, be instances in which there will be material reductions, but in general terms the outlook for marked or rapid decline, at least in the near future, does not seem encouraging.

Liberty 48-Inch Open-Side Planing Machine

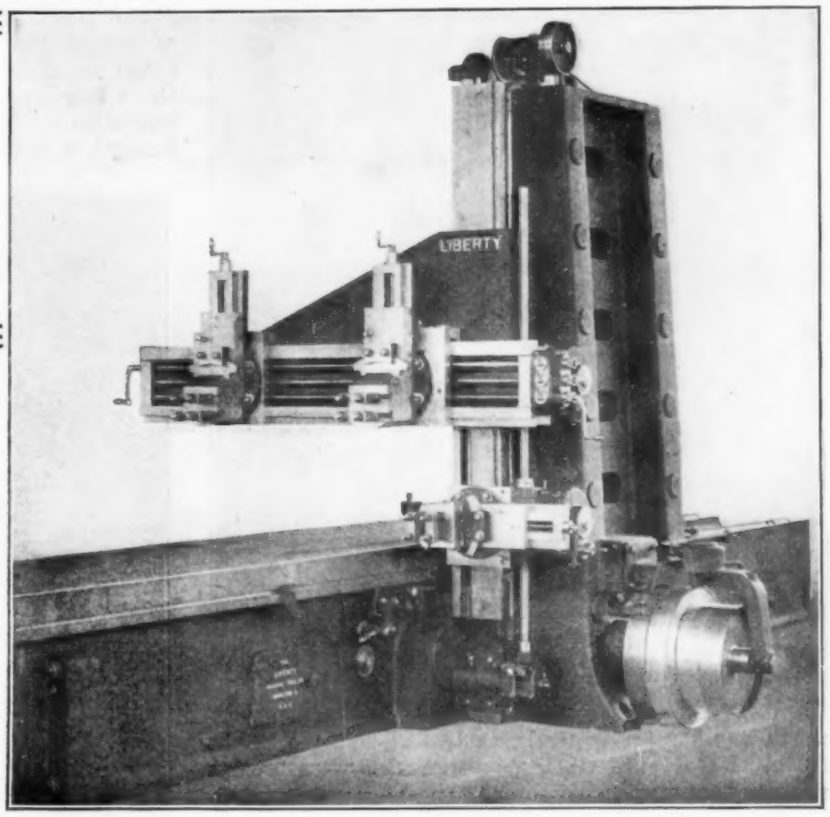


FIG. 1. FRONT VIEW OF LIBERTY 48-INCH OPEN-SIDE PLANING MACHINE

THE illustrations show a new 48-in. open-side planing machine that has just been placed on the market by the Liberty Machine Tool Co., Hamilton, Ohio. The crossrail is triangular in shape with a long narrow guide extending upward on the front of the column, and is bolted and doweled to the triangular brace or knee, which extends to the rear of the column with a tongue in the rear T-slot. This brace is clamped to the side of the column by three T-bolts in addition to the rail clamp on the front of the column, this construction keeping the rail square with the table when the bolts are loosened for raising or lowering. The column is of two-post, box-type construction, extending to the floor, and is bolted and doweled to the side of the bed. The bed extends to the floor to afford a solid foundation and the top is closed in between the ways, except through the gearing section, which is reinforced with heavy girths. The ways are V-shaped and are fitted with automatic oil rollers to insure proper lubrication. A place is also provided on the bed for the operator's tools.

Table Construction

The table is ribbed, and T-slots and reamed holes throughout the entire length afford facilities for clamping work. The driving gear is placed inside of the bed and is accessible from the top. Gears are pressed onto the hubs of the pinions to relieve the shafts of torsional strains, and wick-oiled bronze bearings are used for the shafts. The pulley or driving shaft has an additional support outside of the pulleys, which are made of aluminum with cast-iron centers to reduce the inertia and trouble caused by it at reversal. The loose pulleys have wick-oiled bronze bushings and a solid web instead of arms. The entire belt-shifting mechanism is inclosed to avoid the accumulation of dirt on cams and other moving parts. The belt arms are adjustable to keep the belts in the proper position at all times and have an additional support on the pulley bracket to relieve the fulcrum stud of bending stresses. The machine may be started or stopped from either side of the machine and a safety lock secures the shifting mechanism to prevent accidental starting.

The feed is said to be a decided improvement over the old-style arrangement and has the following advantages: (1) The operator can control or change the feed on the cross-heads at any time without stopping the machine or disturbing the feeds on either right- or left-side heads or vice versa. (2) All parts are well protected, yet accessible. (3) All operating handles and knobs are conveniently located. (4) The amount of feed is indicated by a dial enabling the operator to set the feed to the proper amount to suit various requirements.

The rail heads have long bearing surfaces on the crossrail and are made right and left for close range. They are graduated for swiveling up to 90 deg. in either direction, and have automatic feeds in all directions, operative from either end of the crossrail. The down-feed mechanism is so made that the screws are under tension. The slides are hung on ball bearings and binder screws are provided on both saddles and slides.

The power elevating device is located on top of the column, and is operated by a lever-controlled saw-tooth clutch. The handle must be held in position while operating and any obstruction will instantly disengage the clutch to avoid breakage. All gears are idle when not in use.

The Side Heads

The side head is mounted on the front of the column, is counterbalanced, and can be moved below the top of the table when not in use. The control handles and micrometer collars move up and down with the heads, which can be swiveled up to 90 deg. in either direction. Binder screws are provided on both the saddle and slide, and the tool block is fitted with a self-releasing spring plunger.

The countershaft is equipped with Hyatt roller bearings throughout, and all pulleys are balanced. If desired, the machine can be converted into a double-housing planing machine, as provision is made for adding

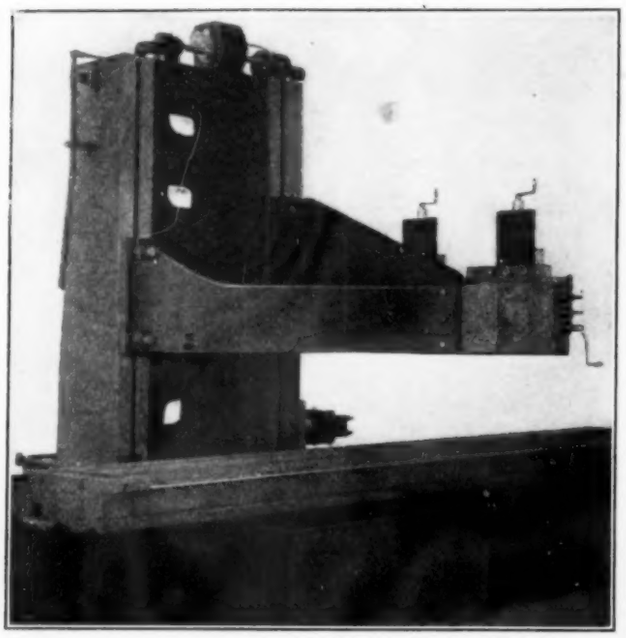


FIG. 2. REAR VIEW OF LIBERTY OPEN-SIDE PLANING MACHINE SHOWING THE CONSTRUCTION OF THE CROSSRAIL AND BRACE

the second housing to the left side. The machine can be furnished for either belt or motor drive. All parts are made to jigs to be interchangeable, and the unit system of construction is used throughout.

Professor Charles B. Richards

Charles Brinkerhoff Richards, Emeritus Professor of Mechanical Engineering, Yale University, died at his residence, 227 Edwards St., New Haven, Conn., on Apr. 20, in his eighty-sixth year.

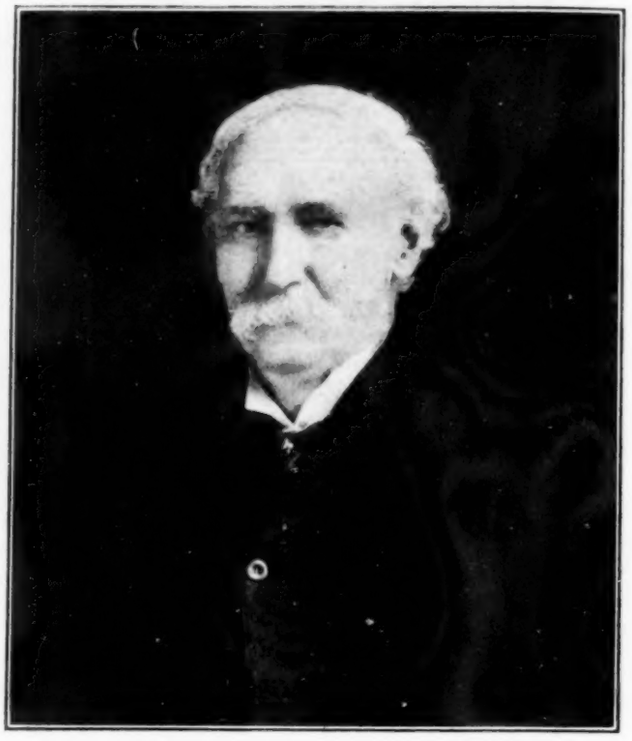
Professor Richards was born in Brooklyn, Dec. 23, 1833, and educated in private schools in that city. In his early days he moved to Hartford, Conn., and upon his removal from there to New York, came in contact with the late Charles T. Porter, by whom he was employed to assist in the preparation of drawings for a machine for drilling the arms and balls for his steam-engine governor.

Professor Richards afterward established himself as a designer of machinery and in 1861 was commissioned by Mr. Porter to design a steam-engine indicator that would overcome the faults of the instruments then in use, and which were only for use on engines of slow speed. After repeated attempts, young Richards became discouraged, but, goaded by Porter's insistance that he must have a high-speed indicator, renewed his efforts and the celebrated Richards indicator was the result. When asked to patent the indicator, Richards refused, saying "If I patent everything I think of I shall soon be in the poorhouse." He finally agreed to sell his right in the invention to Porter for one hundred dollars; Porter to patent it, employing Richards to obtain the patent.

For the achievement of inventing the indicator he was made a chevalier of the Legion of Honor of France.

For many years he was consulting engineer and assistant superintendent of Colt's Patent Fire Arms Co., Hartford, Conn., and while there designed and superintended the building of the two pairs of Porter-Allen engines.

The beds for these engines were cast in the foundry of one of the old engine builders in Hartford, who called on General Franklin, the general manager of Colt's Armory, to warn him that if Richards was permitted to put these engines in the second story of the building and run them at 100 r.p.m. disaster would be



PROFESSOR CHARLES B. RICHARDS

certain. These engines were started in 1867 and have been running continuously since that time.

Professor Richards was superintendent of the Southwark Foundry and Machine Co., Philadelphia, Penn., from 1880 to 1884 and was called from there to take the chair of mechanical engineering at Yale. He served as professor in that branch until 1909, since which time he has been professor emeritus.

He was United States Commissioner to the Paris Exposition in 1889, and has been consulting engineer for many public buildings, notably the State Capitol at Hartford. He was a member of the Société Industrielle de Mulhouse and a charter member of the American Society of Mechanical Engineers, being present at the meeting for organizing the latter society on Apr. 7, 1880.

Reunion of "Eighty-Niners"

Thirty years ago a party of American engineers, members of the American societies and institutions of civil, mechanical, mining and electrical engineers, with their families, sailed for Europe, visiting England and the Paris Exposition of 1889, and were the recipients of many high courtesies—official, professional and individual. Plans have been made for a reunion dinner to be held in New York about May 27, at which it is hoped that all the survivors, ladies as well as men, may meet again. It is requested that anyone who was in the party communicate with the secretary of the committee, Jesse M. Smith, Engineers' Club, 32 West 40th St., New York.

∴ EDITORIAL ∴

It's Our Turn

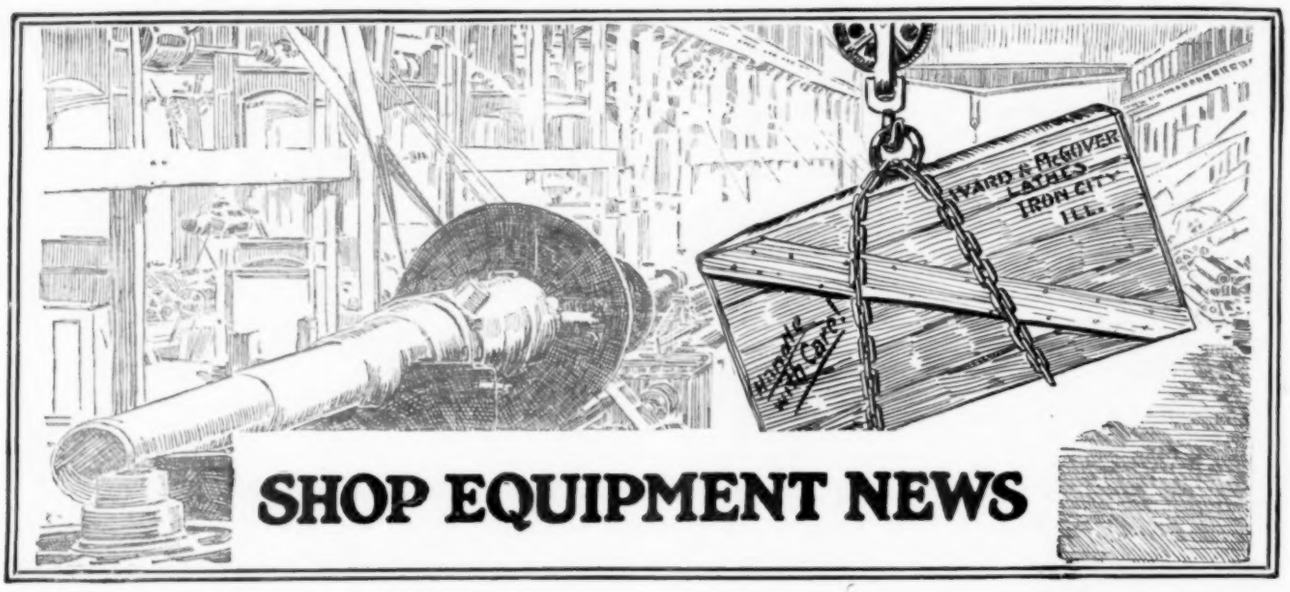
IN PARIS the stage is set for the final scene of the great war, and we are hoping for a quick curtain. Over here we are working for a goal hardly less vital—the over-subscription of the Victory Loan.

Our part in the war has taught us not only the fundamental need of united effort but also our enormous power as a nation when we go after something with all our might. We have seen what can be done when each one of us works his hardest for the common end and subordinates his personal aims. We must keep it up for the task of winning prosperity is, if anything, greater than that of winning the war. This time we haven't the fear of a Hun triumph to stimulate us, but we have the prospect of good round dollars in the pockets of all if we succeed.

Failure of the loan will result in depression, unemployment and hard times instead of the unprecedented prosperity predicted even by some of the most conservative and pessimistic observers of our business. Is such a chance worth taking when a determined effort will avoid it? Isn't it sound common sense to do everything in your power to maintain the get-together spirit of the other loans and push this last and greatest one for all you're worth?

There is also the war-debt balance of several billions. We still have well over a million men in Europe to be fed and paid, and they must be brought home. Don't forget the sacrifices they have made in the light of which your investment in a sure thing seems rather tame.

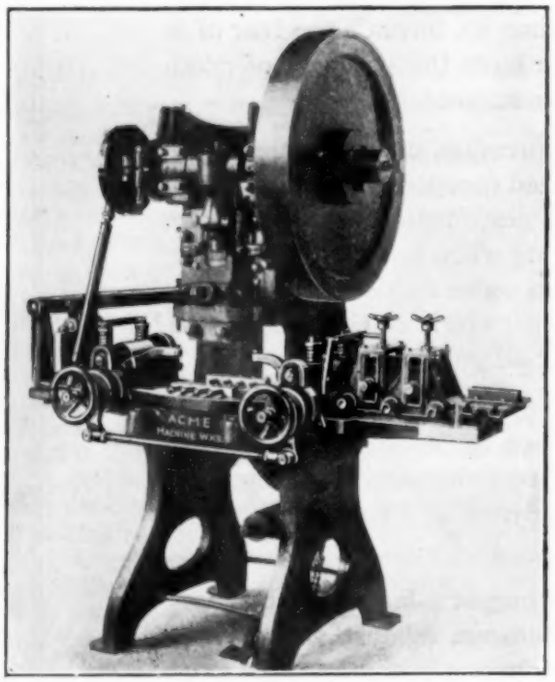
Continued unity of purpose is the strongest safeguard of business in the present crisis and a mighty weapon against Bolshevism. Remember that a property owner is inherently conservative even though the property be only a baby bond. For your own sake as well as for your country, get behind the loan. Talk it at home, in the office, in the factory, and *make* it go.



SHOP EQUIPMENT NEWS

Acme Roll Feeds for Press Work

The Acme Machine Works, 4125 Ravenswood Ave., Chicago, Ill., has announced a new line of roll feeds for power presses, one of which is shown in the illustration. It is believed to be the only roll feed on the market which is built in connection with a straightening device and which has a scrap cutter. The drive is



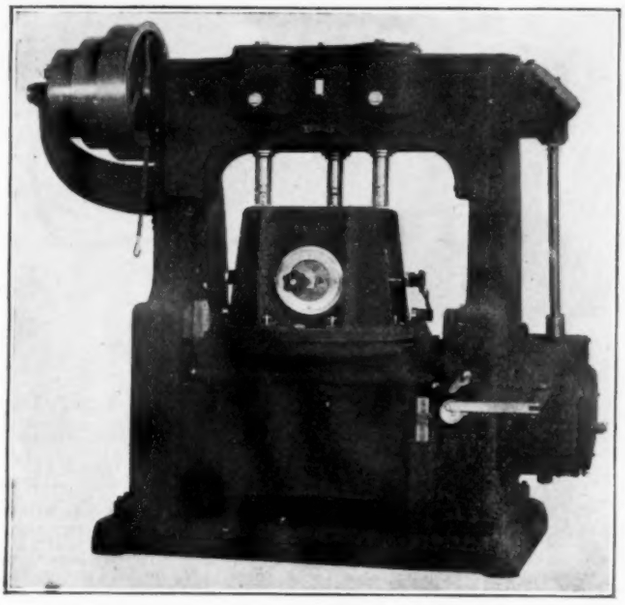
ACME ROLL FEEDS FOR POWER PRESSES

also stated to be a new feature. The roll feeds are mounted on their own bolster plates and are made to fit any make or size of press. The stock first passes through the straightening rolls to remove the curvature caused by coiling. These rolls are hardened and ground, run on roller bearings and are adjusted by means of handwheels for any weight or stiffness of stock. From the straightening rolls the stock passes to the feed rolls which are of large diameter and also hardened and ground. These are fitted with the Acme drive which has from five to seven pawls, each having a toggle grip action. With this driving device the pawls take hold the instant the direction of rotation of the driving housing is reversed, thus assuring accurate and noiseless feeding and an extremely fine adjustment at high speed. All working parts are hardened and ground. The scrap-cutting attachment cuts the scrap into small pieces which drop into a barrel or box relieving the operator from handling the stock, and avoiding the necessity of baling and having the floor littered with scrap. The automatic feed cut-out can be furnished in cases where the stock has to be fed up against a stop-pin; this feed cut-out eliminates the slippage of the rolls on the stock, which is of course undesirable.

Defiance Gas-Engine-Cylinder Boring Machine

The illustration shows a new vertical gas-engine-cylinder boring machine equipped with a circular indexing jig that is a recent product of the Defiance Machine Works, Defiance, Ohio. The speed and feed mechanisms of this machine are somewhat similar to those incorporated in other machines built by this concern, but the rotating-jig fixture, together with the arrangement of the spindles, is said to be a new method of boring gas-engine cylinders. This method allows the machine to produce constantly and saves the time ordinarily lost in loading and reloading the fixture. The machine is a single-purpose tool and is built in three sizes, taking 36, 48 and 60 in. between the housings. The machine can be fitted with either two or three spindles or with two or three groups of spindles. When fitted with three groups of spindles it will rough-bore, semi-finish and ream gas-engine cylinders of either single units or a number of units cast en bloc, these three operations being accomplished at one time. The circular indexing jig is designed to hold four units, this method of construction allowing the three above-named operations to be carried on at the same time the operator is unloading and loading at the fourth station.

Lubrication is secured by means of a force-feed and



DEFIANCE CYLINDER-BORING MACHINE WITH CIRCULAR INDEXING

splash system, this being made possible by the all-inclosed feature of the machine, both the feed and drive mechanism being tightly incased and practically submerged in a bath of oil, while the bearings are lubricated through individual leads from a force-feed mechanism.

The unit method of construction is followed throughout, each unit being accessible without disturbing other parts of the machine. The drive to the spindle is from a three-step cone pulley through steel worms and bronze worm gears, but instead of driving the spindles by means of keys, as in common practice, large tongue drives are cut integral with the spindles and mesh with grooves in the worm gears. This construction is located close to the spindle nose and as used in conjunction with the worm gear is said to effect a very smooth and powerful drive which reduces the possibility of torque in the spindle to a minimum and eliminates the chatter of the cutting tools. The spindles themselves are of hammered stock supported in three bronze bearings. The nose bearings are of conical shape with a means of adjustment, while end thrust is carried on two sets of SKF ball bearings. Momentum of the spindles can be overcome after the power has been shut off by a friction brake located in the drive pulley and operated by a lever within reach of the operator. The boring tools are fitted to the spindles by tapered shanks and are securely held in place by long bolts passing through the spindles, this method of construction eliminating the possibility of the tools being extracted from the spindle on the return feed.

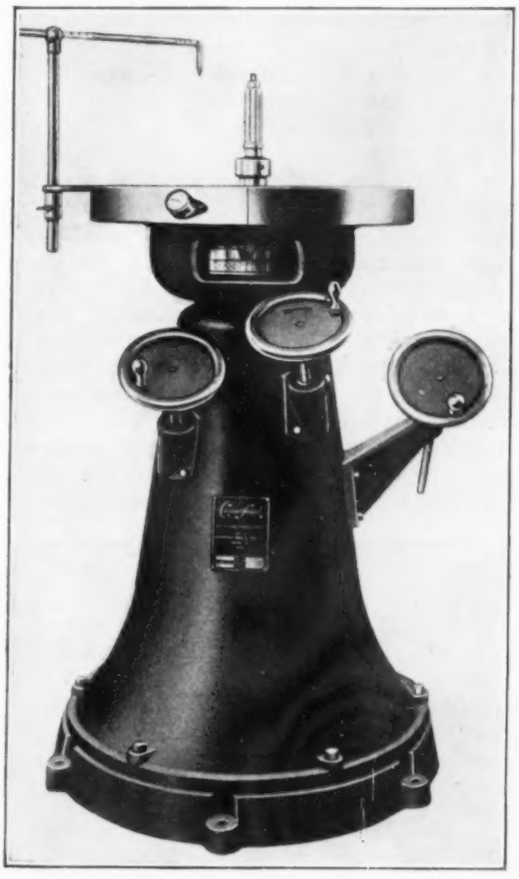
All feed-shaft bearings are bronze bushed while end thrusts are carried on SKF ball bearings. The feed changes can be made by removing the gear-case cover and changing two gears. A hand adjustment for the table is provided, and when in operation the table feeds the work to the cutters and when through, the cut automatically reverses on fast travel, returns to the loading position and stops.

The table is raised and lowered by jackscrews, each screw being retained in a jack and actuated by a worm and gear through a bronze nut which is sleeved to the worm gear. Each jack is a unit in itself, and its contents are packed in grease. A means is also provided for adjusting the screws independently to maintain alignment of the table. All thrusts are carried on SKF ball bearings. The jackscrews are located directly beneath the table and a vertical feed is obtained, eliminating side thrust.

The table, column and base are of cast iron, the table being gibbed to the column on both sides. The column and base are of box section, reinforced, and the base rests on the floor at three points only. The machines are built to specifications as best adapted to special requirements of individual customers.

Crawford Dynamic Balancing Machine

The Crawford Tool and Manufacturing Co., 1617 South Crawford Ave., Chicago, Ill., has just placed on the market the dynamic balancing machine shown in the illustration which is suitable for use on flywheels, pulleys, gearwheels, turbine rotors, waterwheels, connecting-rods, propellers, fans, separator disks, clutch-assembly parts, induction rotors, pistons and other such



CRAWFORD DYNAMIC BALANCING MACHINE

Capacity, work from 4 to 36 in. in diameter and weighing up to 600 lb. at 500 r.p.m.; speed of machine, 250 to 900 r.p.m.; tight and loose pulleys, 4 x 3 in., 1150 r.p.m.; floor space, 3 x 6 ft.; height of table, 44 in.; diameter of table, 24 in.; diameter of base, 27 in.; horsepower for belt drive, ¾; horsepower for direct-connected motor drive, ½; weight of bare machine, 1175 lb.

bodies as must be put into dynamic balance. Other bodies can be balanced with the use of special fixtures. In handling any of the above bodies they need not be in static balance before being operated upon. The machine will indicate by means of the vibration the

place and the weight of the counterweight that must be added. It is stated that the accuracy of the machine is well within ¼ oz. and that the sensibility is such that the machine will show the vibration caused by a weight of ¼ oz. placed at a radius of 5 in. with the machine revolving at 900 r.p.m.

The principle of the machine is stated to be such that the so-called critical speed of the rotating body does not affect the indications of the machine. The operation is said to be very simple, there being little chance for the operator to make mistakes in the indication. The actual indication of the unbalanced body takes 15 to 25 sec., and the time required to place the body on the machine and remove it depends, of course, on the parts and facilities provided. The machine will handle parts from 4 to 36 in. in diameter weighing up to 500 lb. at 500 r.p.m.

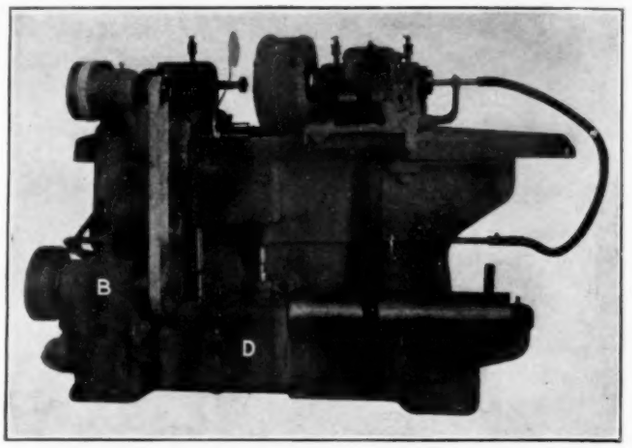
Taylor & Fenn Bore Grinding Machine

One of the latest bore grinding machines to make its appearance on the market, and one that is said to have a number of features that are not incorporated in other machines, is shown in the illustrations. It is the product of the Taylor & Fenn Co., Hartford, Conn.

Fig. 1 is a front view of the machine, while Fig. 2 shows the right end. The machine is entirely self-contained and may be driven from a lineshaft, or an intermediate jackshaft may be used if desired. It will be noticed that the crossfeed instead of being placed under the wheel head, is placed under the work head. This wheel head remains in a fixed position in regard to the base or body of the machine, and is integral with the bridge that spans the table. Both the cross and longitudinal movements are on V- and flat-ways, doing away with all gibs. It is believed that this is the first time this construction has been incorporated in an internal grinding machine. The construction of the V- and flat-ways for the longitudinal movement can be seen in the end view of the machine, Fig. 2.

Another feature which is said to be of great convenience to the operator is the placing of the handwheel for controlling crossfeed. This can be seen just in front of the work head in Fig. 1 and is mounted at an angle so as to be very convenient for the hand of the operator when he is leaning over, watching the work. The pawl lever for the crossfeed is operated at both ends of the longitudinal stroke and receives its motion through the swinging leaf just below the table. This swinging leaf is operated by the trip lever, for the longitudinal feed; this construction making it possible to operate the crossfeed and table reverse with one set of dogs, these being visible on the front of the table to which they are fastened by bolts in a T-slot running along the front edge. The stroke of the pawl lever for the crossfeed is controlled by means of an adjustable nut and screw mechanism just back of the handwheel.

Longitudinal feeds are obtained through a rack-and-pinion mechanism driven from the gear box placed on the back of the machine as shown at *B* in Fig. 3. This gear box gives three feeds, these being changed or con-



MACHINE SHOWING THE LOCATION OF GEAR BOXES AND OTHER MECHANISMS

Capacity of machine, holes 8 in. long and 8 in. deep, it being possible, however, to grind slightly larger holes in emergency; diameter of inside of chuck guards, 12 in.; swing of machine without chuck guard, 14 in.; work speeds, four, arranged in geometrical progression; table feeds, three, arranged in geometrical progression; speeds of wheel spindle, two for each size of spindle, spindle speed furnished ranging from 6000 to 25,000 r.p.m.; width of main driving shaft belt, 1¼ in.; travel of automatic crossfeed, 3 in.; floor space, 42 in. wide, 95 in. long.

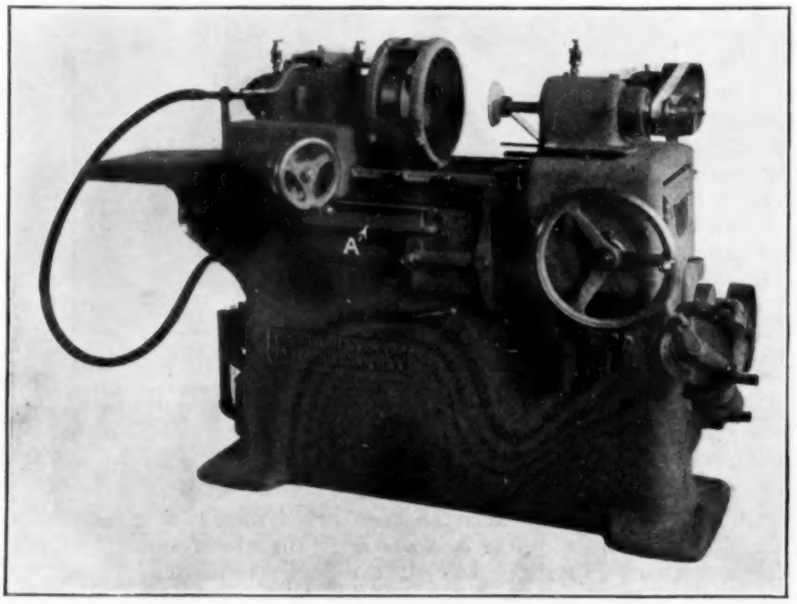


FIG. 1. FRONT VIEW OF TAYLOR & FENN BORE GRINDING MACHINE

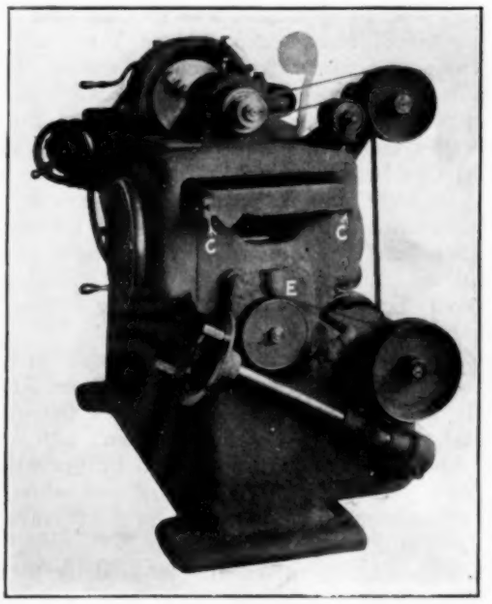


FIG. 2. END VIEW OF THE MACHINE

trolled by the short lever at the left of the sector at the right end of the machine in Fig. 1. It will be noticed that all gear boxes are mounted on the outside of the machine, this method being used in order to overcome the necessity of cutting holes through the base of the machine in order to allow for the installation of parts on the inside. This method of construction is claimed to make the machine considerably more rigid than where the gears and other apparatus are located in the inside.

The work spindle is started or stopped by means of the lever seen projecting from the front upper part of the work head in Fig. 1. This lever operates a brake for stopping the spindle quickly when pushed to the limit of its travel. The spindle is of large size and runs in tapered bronze bushings provided with means for taking up wear. The oiling is by means of sight-feed lubricators. Another feature of the machine is that all shaft holes coming through to the outside of the machine are plugged, in order to prevent dirt getting into the bearings. To prevent dirt or grit from getting on the ways, the table is cupped down over the bed as may be seen at *C* in Fig. 2.

As previously stated, the complete wheel-spindle unit is carried on top of the bridge, which is ribbed and bolted to the bed for solidity. The spindle is belt-driven from the main shaft through a jackshaft located at the back of the head, the belt being of the endless variety in order to prevent vibration caused by lacing.

The speeds of the work spindle are four in number and are controlled by the long lever on the right of the sector located at the front right corner of the machine in Fig. 1. The gears for these changes are also located in the gear box *B* at the rear of the machine in Fig. 3. All gears in this box are lubricated by a bath of oil. The reverse-gear box shown at *D*, Fig. 3, is also oil-tight, lubrication being by means of an oil bath. A notable feature of the machine is that all horizontal shafts connecting these boxes are inclosed in tubing to prevent dirt getting into the bearings, while the hole for each vertical shaft is covered by a sleeve fastened to the shaft and projecting down over a piece of tubing set in the top of the lower box. Fig. 3 also shows how the drum providing for longitudinal motion of the work head is mounted at the back of the machine, obviating the use of a countershaft for this member. It will also be noticed that all gear boxes, etc., are placed at the back and in this position do not interfere with the operator while at work at the front of the machine.

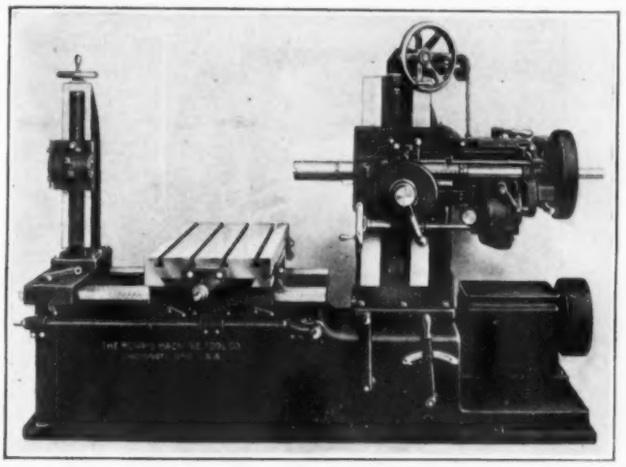
All high-speed shafts turn in ball bearings, while the slow-speed bearings are of bronze. The wheel guard is automatically controlled and may be set from the front of the machine. The large handwheel at the right in Fig. 1 is for hand movement of the table, but this is automatically disengaged when power feed is being used. The machine shown is for belt drive, but a motor-driven machine can be furnished if desired, in this case the main-drive pulley being replaced by a coupling which connects directly to the motor that is mounted on an auxiliary base.

The water pump is just inside of the base of the machine at *E*, Fig. 2 and is of the centrifugal type. A novel feature is the top of the table, which acts as a sediment pan. This is cast with a number of baffle walls and the water or cutting lubricant must travel twice the length of the table before returning to the tank in the base of the machine.

Another feature that might be mentioned is the method of fastening the gear boxes to the bed of the machine, a ledge planed on the bed of the machine locating the boxes in a vertical direction, while a pin placed at the top locates in a horizontal direction.

Morris Horizontal Drilling and Boring Machine

The horizontal drilling and boring machine shown in the illustration has just been placed on the market by the Morris Machine and Tool Co., Cincinnati, Ohio, in answer to a demand for a machine for drilling, boring, facing and tapping operations. The bed is of one-piece box section, ribbed internally and runs down to the floor. The column is also a box section and is bolted to



MORRIS HORIZONTAL DRILLING AND BORING MACHINE

Smallest diameter spindle, 1 1/2 in.; diameter of spindle nose, 3 1/2 in.; taper in spindle nose, Morse No. 5; spindle traverse, 17 1/4 in.; maximum distance between spindle and outer support, 48 in.; size of table, 20 x 36 in.; longitudinal feed of table, 31 in.; crossfeed of table, 28 3/4 in.; height from table to floor, 31 in.; feeds, six, 0.006, 0.009, 0.012, 0.017, 0.022, and 0.030 in. per spindle revolution; spindle speeds, 18 through speed box, 15 on pulley, 20 to 350 r.p.m.; driving pulley on speed box 14 x 3 3/4 in., 400 r.p.m.; size and speed of motor 5 hp., 1200 r.p.m., net weight, 6500 lb.

the base. The bed moves on ways arranged with taper gibs, adjustable for wear, and is counterbalanced, the handwheel at the top of the column serving to raise or lower the head. A steel scale graduated in sixteenths of an inch is set into the column, and this in connection with the micrometer column on the head elevating screw enables readings in thousandths to be obtained for the full travel of the head.

The spindle is of forged high-carbon steel ground to size, the thrust being carried on ball bearings. The sleeve is graduated and provided with a direct-reading depth gage. The spindle drive gears are helical, this construction giving smoothness of action and the elimination of chatter. The back gears are of 3 1/2 per cent. nickel steel, heat-treated and hardened, and are fully inclosed and mounted as a unit on the back of the head. The speed box is mounted on the bed with the gears fully inclosed and running in light grease. Six speeds are provided controlled by two vertical levers on the front of the bed below the column. The lever at the left controls the double friction clutch and pulley shaft, and the other lever the three sliding gears. The feed box is also a unit mounted on the head, the gears being inclosed and running in oil. Six speeds are provided that can be automatically tripped at any depth within the traverse of the spindle.

The bearings throughout are of bronze arranged with oil chambers, the oil being drawn into the bearings by felt wipers. The machine shown is for belt drive, but motor drive can be furnished if desired. In this case a three-to-one variable-speed motor is connected to the lower shaft by one pair of gears or a constant-speed motor used in connection with the speed box.

Gale-Sawyer Self-Tightening Inserted-Tooth Milling Cutters

A line of self-tightening inserted-tooth milling cutters, similar to the ones shown in the illustration, has just been placed on the market by the Gale-Sawyer Co., 36 Oliver St., Boston, Mass. The features claimed

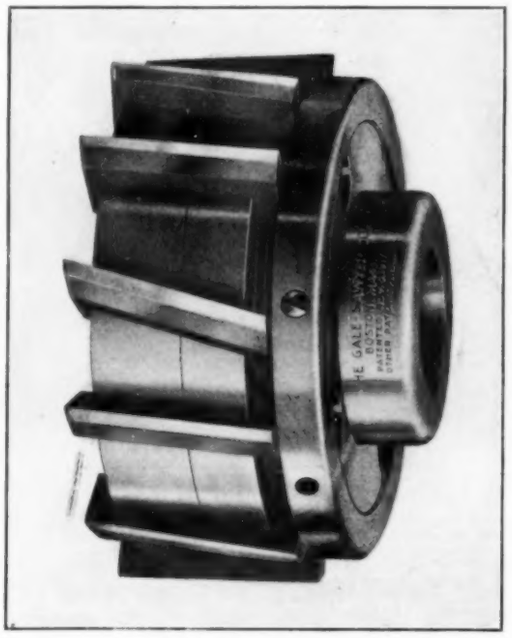


FIG. 1. GALE-SAWYER INSERTED-TOOTH MILLING CUTTER

for the new line of cutters are that the pins and other small parts generally used in fastening the teeth in place are done away with; the method of holding the blades makes it impossible for them to become loose or change position while the cutter is in operation; the harder the cutter is driven the tighter the blades will be held, and that it is impossible for the cutter to become frozen on the arbor or shank due to excessively heavy work.

The body is made in two sections. These two sections are slightly separated and the slots for the cutters or teeth are milled for the insertion of the blades, the alternate slots being at angles of 7 and 15 deg. with the center line. Fig. 1 shows an exterior view of the cutter while Fig. 2 shows a cross-section. After the slots have been milled and the blades put in place, the cutter is screwed onto the spindle or adapter, this operation serving to press the sides together, and to clamp the blades securely on account of the differing angle of alternate teeth. It will be noticed that about midway between the spindle and the outside edge are screws, four in number, these serving to loosen the cutter when removing from the spindle or adapter. By turning the four relieving screws to the right about one-quarter of a turn the shank or adapter is released and can be easily removed. To remove one or all of the blades, the relieving screws *A* are tightened by turning to the right about one-quarter of a turn. The shank or adapter *B* will then turn out easily and should be backed out four turns. The relieving screws *A* are then turned to the left until they strike the bottom of the hole *C*, after which the further motion of one-quarter of a turn will release the blades, the exact point at which these will slide easily corresponding to the position of the two sections when the slots were originally milled.

It should be stated that the bottom of the tooth is made wider than the top, this construction preventing

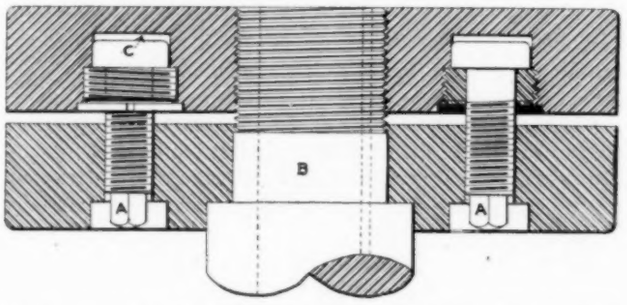
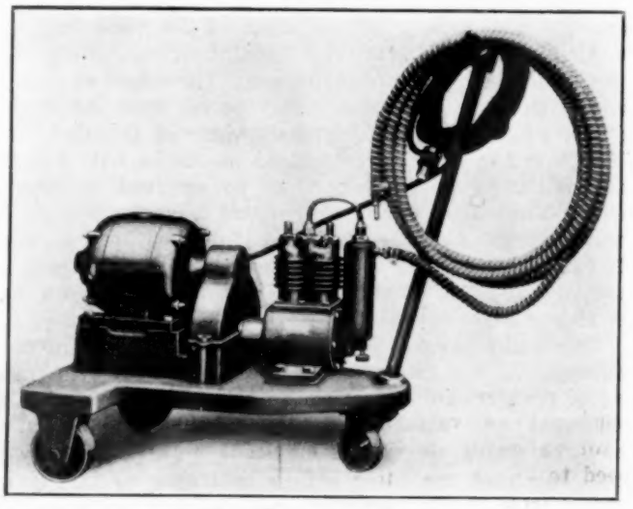


FIG. 2. A CROSS-SECTION OF THE BODY OF THE CUTTER SHOWING THE METHOD OF FASTENING AND RELEASING THE BLADES

the tooth moving out in a radial direction. The construction of the cutter lends itself readily to all methods of fastening on the nose of the spindle on any milling machine, as any type of adapter can be readily made to suit conditions. The company is prepared to furnish adapters of any type as required to suit the machines on which the cutters are to be used.

"Master" Portable Air Outfit

The illustration shows the "Master" portable compressed-air outfit on which a number of changes have recently been made by its manufacturers, the Hartford Machine Screw Co., Hartford, Conn. The outfit is said to be very useful in cleaning machine parts and can be readily transported from place to place about the shop and connected to any regular electric-light socket. A new motor is now being fitted. The pump is a two-

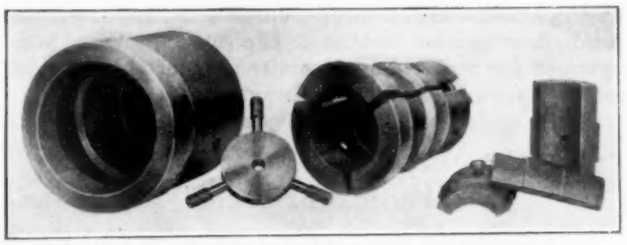


"MASTER" PORTABLE AIR OUTFIT

cylinder machine, a small expansion chamber being used instead of a regular tank. The bore of the pump is 1¾ in., the stroke 2 in. and the motor is of ½ hp. The outfit shown is mounted on a metal truck with three wheels, but a stationary outfit is also manufactured.

American Parallel-Grip Master-Hinge Collet Chuck

The illustration shows a new type of collet chuck being manufactured by the American Pneumatic Chuck Co., Chicago, Ill., and marketed by Neidow & Payson Co., 9 South Clinton St., Chicago, Ill. The important departure from the usual type of collet chuck is that



PARALLEL-GRIP MASTER-HINGE COLLET CHUCK

with the parallel grip the work is held with the same pressure the full length of the gripping surface, irrespective of any variation up to ¼ in. in size or taper. The device is made with an open rear end for bar work. The pull of the draw rod is directly on the jaws, the hinge pins not being subject to stress, causing the pin holes to become elongated or the jaws to lose alignment. A long slow taper bearing on the front end of the jaws is provided to insure a powerful grip and long wear, but the gripping power may be adjusted so that thin walls will not be crushed. All parts subject to wear are hardened and ground and the regular equipment includes master jaws with open rear end. False jaws either blank or shaped to the work, and an adjustable stop, can be furnished as extras. The chuck can also be made with two or four jaws instead of three if desired. It is regularly made in 2-, 3-, 4- and 6-in. sizes with outside diameters of 4⅝, 5¾, 6⅞ and 9 in. respectively, and lengths of 4, 4½, 5¼ and 6½ in. respectively.

Beaman & Smith Slot-Milling Machine

This machine was designed for milling internal grooves in gun carriages, but can be readily adapted for slotting any hole over 7 in. in diameter within practical limits. The bed is of the box type and carries individual motors for the cutter and feed, as well as the milling-bar supports and a revolving table for cutting two slots with one set-up of the work. Fast forward and reverse motion are provided for the milling bar. The cutter is carried on a vertical spindle in a steel bar and is driven through reduction gearing by a variable-speed motor, allowing the spindle speed to be adjusted to meet requirements. The spindle is mounted on New Departure double- and single-row ball bearings at the head and tail end respectively. The bar is ground to a sliding fit in the support brackets, and the end which carries the cutter is clamped securely in a bearing on the saddle after being located by a dowel pin in the bearing. Adjusting screws in the bottom of this bearing work against the pin in the bar, which turns sufficiently to allow accurate alignment of the cutter, this device locating the dowel hole in successive bars when it is desired to take more than one cut in the same slot. The dowel pin has a threaded end to allow its quick removal, and when once the dowel hole is located the cutter bar can be quickly set.

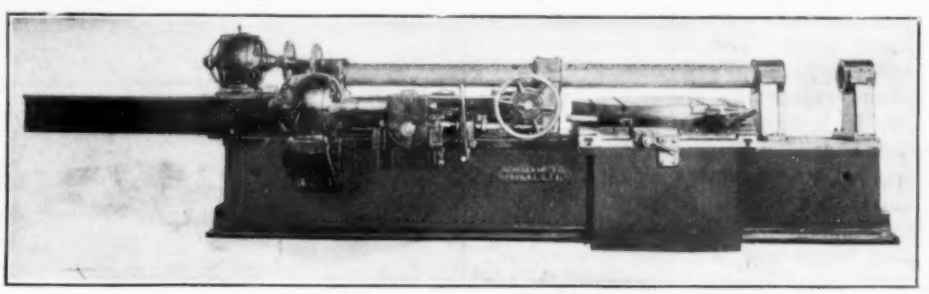
The spindle-drive shaft in the bar is connected to the main drive shaft by a coupling located immediately behind the clamp bearing on the saddle, this construction allowing for the rapid changing of cutter bars. The saddle carries the cutter-bar motor and reduction gearing and travels on flat-ways on a slide attached to the bed. The bearing surface is more than three times as long as it is wide, to insure accuracy of alignment, and wear is taken up by a gib. The feed nut attached to the bottom of the saddle is of bronze.

The feed and rapid traverse are by means of a motor carried at the front of the machine, the rapid traverse being operated by friction clutches controlled by a lever at the front. Close beside this lever is the feed handwheel, power being applied to the feed screw by a clutch in this wheel. With the clutch out, hand feed or rapid traverse in either direction are available, and with the clutch in, power feed in one direction only is available. Two changes of feed are secured through change gears and a large variety through the variable-speed motor, ranging from ½ in. to 4½ in. per minute, the rapid traverse giving from 4 ft. to 12 ft. per minute.

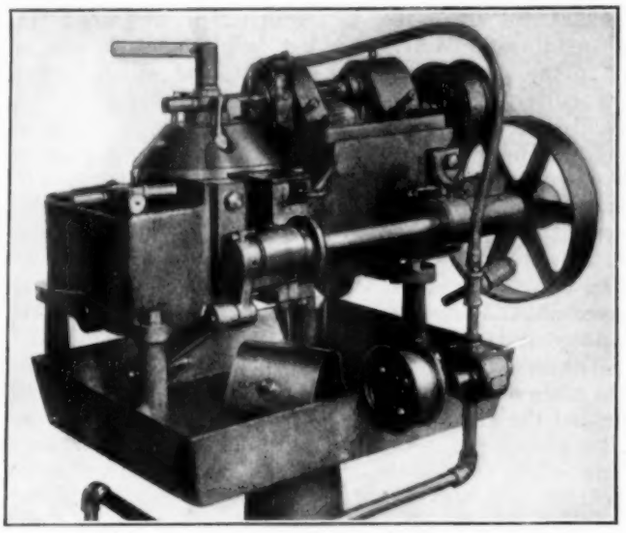
The revolving table carries the work and is operated by hand. It is attached to the bed and set so that the top is the proper distance from the cutter. The function of the table is to turn the work around in order to slot the opposite side without changing the set-up. The table is carried on ball bearings, when in motion, but when in working position it is clamped flat upon a large bearing. A taper latch serves to locate it accurately. The Beaman C. Smith Co., Providence, R. I., is the manufacturer.

Porter-Cable Differential-Cross Centering Machine

The machine shown in the illustration is shown centering the arm of a differential cross. This machine bores and reams the center holes through the hubs and faces the ends, and is the product of the Porter-Cable Machine Co., Syracuse, N. Y. The work is clamped to the indexing turret by means of an arbor through the hub and the indexing mechanism is arranged to turn



BEAMAN & SMITH SLOT-MILLING MACHINE



DIFFERENTIAL-CROSS CENTERING MACHINE

the cross 90 deg. after each operation. The centering tool is a regular combination drill and countersink. The indexing and feed of the tool are automatic and a circulating pump provides lubricant. The capacity of the machine is said to be approximately 90 crosses per hour.

Cincinnati 30-Inch Special Forge Planing Machine

The Cincinnati Planer Co., Cincinnati, Ohio, has just brought out the special new planing machine shown in the illustration, which is known as the company's special forge planer. It is a 30-in. machine and is said to have been designed throughout for extra-heavy duty, special care having been taken in the design of the side heads. The bed is heavy, of box section, and strengthened where the gearing and uprights are mounted. Oil reservoirs are cast in the girths at each end of the bed, and catch the oil used and hold it until drawn off through the plug in the end of the bed. The table is also of the box type, heavy and deep, the bottom being entirely closed so that no chips can go through the table. Ribs tie the top and bottom together at short intervals to prevent springing, either when clamping the work or when the table is at the limit of its travel. The table is also gibbed to the bed to prevent any tendency to rise as the tools enter a heavy cut.

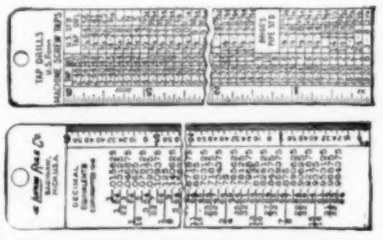
The housings are of box type and are keyed, bolted, and pinned to the bed, and tied together at the top by a heavy arch. The side heads can be run down completely out of the way of the rail, which has a box brace on the back to give additional stiffness. Two heads are provided, right and left hand, so that they can be run close together. The slides have a full bearing on the harp at all times and the heads are equipped throughout with taper pins to compensate for wear.

The tool blocks are of heavy design, arranged so that the tool will be held in a perpendicular position at all times. The construction of the side heads is massive, as is also that of the saddles, which have extra supports on the inside of the housings. These saddle supports are angle plates bolted to the inside of the housing, and not only furnish a bearing but carry an inside clamp for the saddle. In designing the side head, the harp was dispensed with and the slide given a square-gibbed bearing directly in the saddle, this construction decreasing the number of parts and increasing the strength and rigidity of the head. The heads are counterbalanced by a self-contained system of weights.

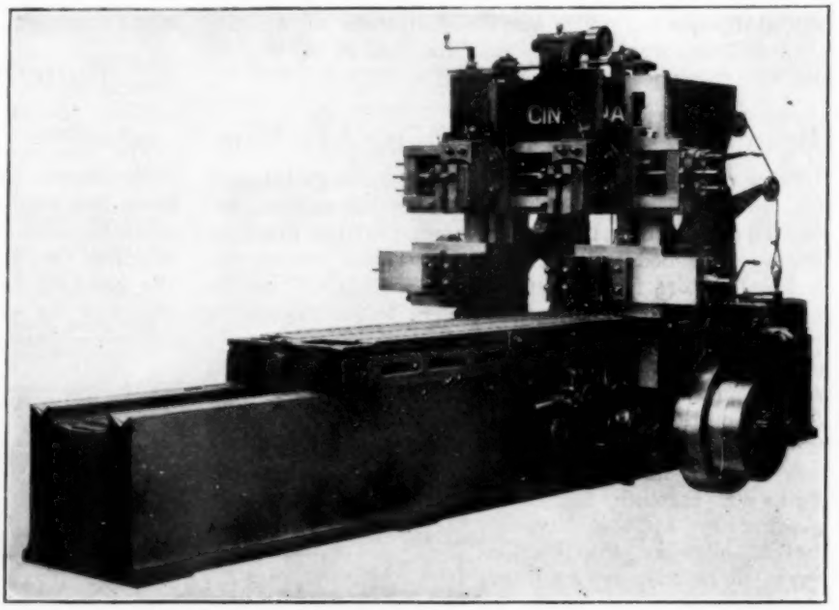
Vertical and horizontal power feeds are supplied to each head from the same friction that operates the rail heads. All gearing and racks are of steel, the driving gears being of chrome-nickel steel, and the high-speed bearings of bronze. The machine has been arranged for motor drive from the top of the housing, but any type of drive desired may be obtained.

Lufkin Mechanic's Steel Reference Table and Scale

The Lufkin Rule Co., Saginaw, Mich., has just placed on the market a mechanic's steel reference table and scale, the two sides of which are shown in the illustrations. This is known as the company's No. 97½ rule. As may be seen, the device carries on one side tables of tap and drill sizes, U. S. Standard, including frac-



LUFKIN STEEL REFERENCE TABLE AND SCALE, SHOWING THE MARKINGS ON BOTH SIDES



CINCINNATI HEAVY-DUTY SPECIAL FORGE PLANING MACHINE

tional as well as numbered sizes; also S. A. E. and Briggs pipe standard, and a 6-in. scale graduated in 32nds of an inch. The other side carries a 6-in. scale graduated in 64ths of an inch, with the improved feature of readable graduations, and a table of common fractions and their decimal equivalents. The device is in the form of a semi-flexible 6-in. steel rule, 1¼ in. wide, and has legible figures throughout. It is convenient to be carried in the pocket and also has a hole at one end so that it may be hung up.

High-Speed Riveting Hammer

The High Speed Hammer Co., Inc., Rochester, N. Y., has just placed on the market the new riveting hammer shown in the illustration which will produce full round heads cold from ⅜ to ¾ in. and oval heads of from ⅞ to 1½ in. The machine is said to be sufficiently heavy to stand up under the constant vibration required, the bronze vibrator, which is the connecting link between the hickory helve and rubber cushions, constituting the member through which all shock is transmitted to the helve where it is absorbed. This vibrator is of solid bronze and weighs 40 lb. The eccentric and rear main shaft are made from one solid piece of special steel ground to size and mounted on ball-thrust bearings. The bearing between the eccentric and eccentric strap is of the Hyatt roller type. The anvil block is provided with rack and pinion and gear for easy adjustment. The peen is revolved by a worm and worm gear, this feature being incorporated to produce a finish on the rivet heads.

HIGH-SPEED RIVETING HAMMER

Capacity, round heads, ⅜ to ¾ in. in diameter, oval heads, ⅞ to 1½ in.; height, 6 ft.; length of hickory helve, 2 ft. 8 in.; horizontal gap, 16 in.; vertical gap, 16 in.; dimensions of base, 2 ft. x 3 ft. 8 in.

The Electric Drive of the Battleship "New Mexico"

The successful application to the driving system of the battleship "New Mexico" of the results of experiments with electric motors on the collier "Jupiter" is cause for congratulation of the Navy Department and its engineers and of the General Electric Co., who built the units.

For some years small boats have been driven by direct-current electric motors. For larger craft the installation of induction motors receiving current from high-speed turbine-generators where maximum efficiency could be combined with minimum weight has seemed very attractive to engineers. The ease of operation and improved maneuvering qualities of the "Jupiter" when so equipped were so marked that the decision was made to obtain the same advantages for our largest fighters. The requirements for the application of the system to the "New Mexico," a 32,000-ton ship, were for highest economy both at high speed and full power at 21 knots, and at medium speed of 15 knots where the maximum cruising radius without refueling is of the greatest importance. To meet these conditions a changeable-pole motor was mounted on each of the four shafts, all four motors taking power from two generators when at full speed and from one when cruising.

New Type of Winding

As the motors and generators were to be designed especially for this job and were to work together, it was feasible to devise a new type of winding, the coils of which were so grouped that a change in the connection at the motor terminals would give a balanced quarter-phase distribution for either 24 or 36 poles. At speeds from 8 to 15 knots the four motors are operated on the 36-pole connection from one generator with its winding connected in parallel, the switching being arranged so that either generator can be used. At speeds from 15 to 17 knots the motors are thrown over to the 24-pole connection, still on one generator. Above a speed of 17 knots two generators are used, connected in two squares. For reversing, the 36-pole connection is used. At a speed of 21.5 knots the screw is brought to full-speed astern in 20 seconds. The speed variation is obtained by steam control on the turbine.

Elaborate safety devices and interlocking switches are provided to prevent accident, and adequate arrangements for cooling the motors and generators have been made.

The electrical units are very similar to land machines of the same capacity except that, owing to the different operating conditions, it has been possible to reduce the weights considerably by substituting steel for cast iron in some places and by modifying the design.

The trials of the "New Mexico" were attentively watched by the naval experts and the designing engineers who were invited to be present and all were impressed by the manner in which the various parts stood up to the tests and exceeded the requirements. The accompanying table gives an idea of the relations existing between the calculated and the actual performance.

Speed in Knots	Estimated Horsepower	Actual Horsepower	Estimated r.p.m.	Actual r.p.m.
10	2,550	3,200	75.0	78.4
15	8,350	10,350	112.0	115.6
19	18,650	24,350	144.5	149.2
21	26,300	32,480	161.0	166.7

Sparks from the

Special Board for War Contract Claims

Established by the War Department and Known as Board of Contract Adjustment for Hearing Appeals

The War Department authorizes the following statement from the War Department Claims Board, of which Hon. Benedict Crowell, Acting Secretary of War and Director of Munitions, is the president:

The attention of the War Department has been directed to the fact that several privately owned organizations or agencies have been created for the purpose of preparing or presenting to the War Department for adjustment, payment or discharge, contractors' claims arising out of the suspension or termination of contracts.

While the War Department, of course, can have no objection whatever to contractors availing themselves of any facilities for the presentation of claims which may seem desirable to them, it is important that it be clearly understood that the organizations and agencies referred to above are of a purely private character and have absolutely no official connection with the War Department.

There has been set up within the War Department a comprehensive organization for the consideration and disposal of all claims arising under contractual relations, implied or expressed, with the War Department.

There has also been set up a special board known as the Board of Contract Adjustment for the purpose of hearing appeals on petition of the contractors from any decisions made by the bureau boards. Any contractor, who, after due negotiation with the settlement board of any supply bureau, feels that the award of settlement offered to him is not just has the right to file a petition on appeal with the Board of Contract Adjustment, which will then review the case, making settlement direct or returning it to the bureau board with directions as to basis of settlement. The contractors, submitting their claims to the Board of Contract Adjustment, are not required, in any degree, to waive their right of appeal to the Court of Claims in the event they are unwilling to accept the decision of the Board.

It is therefore believed that every facility has been afforded contractors for the prompt and efficient determination of their rights as claimants. Every claim, whether under express or implied contract, will receive careful and full consideration while settlements in every instance will be made as promptly as possible.

The War Department, at all times, will give claimants full information concerning the presentation and handling of claims and no one should feel that any information at the disposal of the War Department may be more readily obtained through the intervention of a privately owned organization or agency.

Claimants may apply either personally or in writing to Maj. Erskine Bains, Recorder of the War Department Claims Board, Room 2402, Munitions Building, Washington, D. C., for any information concerning filing of claims against the War Department and this information will be given promptly and in as full detail as possible.

The War Department desires especially to point out that claims presented direct by contractors will receive the same attention as those presented through a claims organization or agency.

Colonel Hayden Eames Delivered the Goods

Col. Hayden Eames who has traveled all over the world may be said to inherit his taste for travel. He was born in Shanghai, China, his parents having gone there from the State of Maine, U. S. A. He came to this country when he was about eight years old. At the age of 14, he entered the U. S. Naval School, graduating in 1882. After having served in the naval service on this coast, in Northern Europe, the Mediterranean, the West Indies, South America and West Africa, Colonel Eames resigned on Mar. 14, 1894.

Since his resignation he has been either in charge of, or financially interested in, industrial and mercantile enterprises of various kinds. Upon his return in the summer of 1917, from a business sojourn in Russia, he immediately volunteered his services to the Navy Department, but on account of his experience in small arms, machine guns and ammunition production for the Navy, he was sent for to take charge of production for this class of articles for the Army Ordnance Department. How ably Colonel Eames succeeded in handling this task is evidenced by the remarkable achievement of the small-arms section in the matter of production, for which he was very largely responsible. Everybody is familiar with the rifle situation as it was when we entered the war. Apparently there was no hope for an adequate production of rifles. Yet in spite of this alarming outlook every soldier of the A. E. F. has been adequately armed with small arms and the accomplishment of the Small Arms Section in so doing represents one of the most creditable pieces of work of the Ordnance Department.

* * *

Clubs Hold Joint Meeting

The Machinery Club and the Rotary Club of Chicago held a joint meeting in the club rooms of the Machinery Club on Thursday evening, Apr. 10. The meeting was held with the view of increasing the acquaintance of the members of these two large business men's clubs. A dinner was served in the dining room of the Machinery Club and a program of home talent from both clubs furnished the entertainment.

World's Industrial Forge

By E.C.Porter, News Editor

Joint Convention of Two Drop Forge Associations

The American Drop Forge Association will hold its sixth annual convention jointly with the Drop Forge Supply Association, June 12, 13 and 14, at Pittsburgh. The convention headquarters will be the William Penn Hotel.

The following are the officers of the American Drop Forge Association: President, E. J. Frost, Frost Gear and Forge Co., Jackson, Mich.; vice president, J. F. Connelly, Champion Machine and Forging Co., Cleveland; secretary, A. W. Peterson, *American Drop Forger*, Pittsburgh; treasurer, E. B. Horne, Packard Motor Car Co., Detroit.

The officers of the Drop Forge Supply Association are as follows: President, H. N. Talyor, N. & G. Taylor Co., Philadelphia; vice president, Charles Harmon, Jr., National Machinery Co., Tiffin, Ohio; secretary-treasurer, A. L. Wurster, Sizer Forge Co., Bourse Building, Philadelphia.

The local entertainment committee is as follows: For the American Drop Forge Association, A. W. Peterson, *American Drop Forger*, Pittsburgh, and T. W. Siemon, Union Switch and Signal Co., Swissvale, Penn.; for the Drop Forge Supply Association, Floyd Rose, Heppenstall Forge and Knife Co., Pittsburgh, and Charles E. Hill, Crucible Steel Co. of America, Pittsburgh.

Technical papers on the following subjects will be read and discussed: "Electric Welding as Applied to the Forging Industry"; "Testing of Materials"; "Powdered-Coal Developments in the Forging Field"; "Sand Blasting versus Pickling"; "Heat-Treating Problems That Originate in the Forge Shops"; "Forge-Shop Profits"; "The Die Factor in Selling Forgings"; "The Low-Pressure Exhaust Steam Turbine," and "The Bonus System in the Entire Forge Shop."

* * *

Enlistments for the Air Service

The Air Service of the Army, as reorganized by Maj.-Gen. Charles T. Mencher, has been given authority by the General Staff to include enlisted men up to about 15,000. Under the terms of the draft act, the men who are now in the Air Service, will be discharged, and if flying is to persist as a major branch of the army, some of these men must reënlist, or others must be attracted to fill their places. To this end the Air Service has begun a nation-wide recruiting campaign, the work in the Eastern Department being under the direction of Major J. McClintock, 104 Broad St., New York City.

"At the present time," says an Air Service statement, "enlisted men constituting the Air Service Forces are men who have been in for the period of the war and most of them are extremely desirous of severing their connection with the Army. It is thought that from among this number who desire to get out of the service, if the proper inducements the Air Service is able to give, were presented to them in the right light, they could be induced to stay in for a period of one year."

It is possible at this time for these men to take their discharge, receive the $60, that is allowed each discharged man, reënlist in the Air Service for one year, then be given one month's furlough, and in most cases it will be perfectly possible for that man to retain the non-commissioned grade that he has attained, and upon this reënlistment, in addition to the $60 allowed each discharged man, be allowed five cents per mile to his home. Inasmuch as he can obtain a one-cent-a-mile rate when going on a furlough and return to his proper station, he can save from this amount a certain nominal sum.

There is not any particular advantage for enlisted men who have not had previous experience, to enlist for one year, because the Air Service cannot guarantee teaching them any trade. However, for men who have had service in the army, it is believed that there is a decided advantage for the period of one year enlistment.

The Air Service enlisted personnel is composed of the following skilled workers: Chauffeurs, auto mechanicians, auto-engine repair men, carpenters, radio operators, electricians, instrument repair men, coppersmiths, armorers (machine-gun repair men), sailmakers, photographers, machinists, blacksmiths, motorcycle repair men, stenographers, cabinet makers, draftsmen (mechanical), magneto repair men, metal workers, automobile engine testers, rope riggers (cordage workers), propeller makers (airplane), riggers (airplane assemblers), telephone linemen, toolmakers, vulcanizers, welders, telephone operators, motorcyclists, plumbers, painters, tailors, gas works employees, molders, patternmakers, telephone adjusters, truck masters, propeller testers (airplane), boat builders, saddlers, and stock-keepers (experts).

* * *

Ordnance Circular for Recruits

A circular has been issued by the Ordnance Department entitled "Information for Recruiting Officers and Applicants." This circular contains information on what ordnance is; what ordnance pays its soldiers; what sort of men ordnance needs; what the projected ordnance training courses are; and what ordnance experience means to men.

The National Metal Trades Association

The Committee on Industrial Education Makes Its Report—Other Papers Read, and Election of Officers

The twenty-first annual convention of the National Metal Trades Association was held in New York on Apr. 23 and 24, and was well attended. After the usual reports of officers, Harold C. Smith of the Illinois Tool Co., chairman of the committee on industrial education, reported on a tour of inspection made by members of this committee to various plants in Providence, Worcester, New Haven, Bridgeport, Stamford and Buffalo; they are unanimously agreed as to the necessity of more intensive training in the metal-working industry.

The training of workers is now carried on under five general plans: Apprenticeship, trade and continuation schools, instruction by foremen, special training in plant, and vestibule schools.

The apprenticeship systems and trade schools have for their object the manual and technical training of boys and young men in a particular craft or trade which they may select. These methods have been covered by previous committee reports and it is the opinion of the present committee that their value has already been proved. They emphasize the desirability of each member training apprentices in proportion to the number of journeymen craftsmen employed, and supporting the trade and continuation schools wherever they are in existence.

The committee desires to point out, however, that apprenticeship and trade schools are particularly designed to take care of young men who wish to learn a trade in all its branches, and are not generally adaptable to the instruction and up-grading of unskilled workers.

The system of instructing by foremen is perhaps most universally employed and consists in putting the workmen directly under the supervision of the foreman in charge, who is entirely responsible for their success or failure. The observation of the committee is that the particular objection to this method is that the foreman, being responsible for the success of his department, in a great many instances, has not the time nor the patience to properly instruct the worker, nor the ability to impart his own knowledge.

There is also the possibility that prejudice on the part of the foreman may prevent him from properly instructing the worker in the performance of the required operations, the result being a lack of efficiency and consequent loss to both the employer and worker.

A system of special training in the plant consists of training in the department by a general instructor. This has some of the advantages of the vestibule school, and in the opinion of the committee is preferable to instruction by foremen.

The vestibule-school plan came into prominence during the war. As the name implies, it is intended to be the worker's entrance to the factory, and while by no means supplanting apprenticeship, it is adaptable in some form in every shop and goes far toward solving the problem of the shortage of skilled labor. It has been applied very largely to the intensive training of workers for repetition work, and has also been used to train specialists as operators of particular types of machine tools. To this school should be sent all accepted applicants, where their fitness or unfitness is determined. The length of time spent in the school depends upon the skill students possess at the start, their aptness, and the character of the work they are to be taught. The committee found in the schools visited that the training time varied from three days to three months.

Many of the thousands of men and women from all walks of life, trained to high efficiency as specialists in the vestibule schools during the war, continue to retain their positions, and in numerous instances surpass in production workers trained under other systems.

A system so wide in its scope and so general in its application can be only outlined in such a report as this. It must also be remembered that local conditions will determine the adjustment of the course to the members' needs. The committee is strongly of the opinion that intensive training will in a large measure assist in successfully meeting the competition of the world. It has, therefore, decided to recommend to the national executive committee the employment of a man specially qualified in this work, whose duty will be to further industrial training in the individual plants of the members. In the meantime, the committee hopes to receive the individual expressions of the members as to their experience in the various forms of training which may already be established in their plants, and the desirability of the association becoming more active in carrying on a campaign for the intensive training of workers.

Following this were talks on "Our Constitution, the Antidote for Bolshevism," by Harry F. Atwood; "The 'Dust' in Industry," by Frank Jewel Raymond; "Work of the Department of Commerce and Its Relation to Business," by Hon. Wm. C. Redfield; "Problems in Shipbuilding," by Howard Coonley, vice president, U. S. Shipping Board, and "Industrial Democracy," by Rev. Charles Aubrey Eaton.

The officers for the ensuing year are: President, John W. O'Leary, Arthur J. O'Leary & Son Co., Chicago, Ill.; first vice president, Murray Shipley, the Trailmobile Co., Cincinnati, Ohio; second vice president, Albert E. Newton, Reed-Prentice Co., Worcester, Mass.; treasurer, F. C. Caldwell, H. W. Caldwell & Son Co., Chicago, Ill.

A Successful Meeting of Gear Makers

American Gear Manufacturers' Association Held Its Annual Convention in Cleveland and Was Well Attended

The annual convention of the American Gear Manufacturers' Association, held in Cleveland on the dates of Apr. 14 and 16 inclusive, was exceptionally well attended. More than three-quarters of the member companies were represented and some of these by four to five officials from each. An exceptionally interesting program had been prepared so that in addition to giving the members of the association an opportunity to get together and become better acquainted, they also had a chance to discuss many of the trade problems which they meet in connection with the conduct of their regular business affairs.

The standardization committee reports show that while nothing as yet can be considered in its final form in this respect, still the amount of work which this committee is performing is stupendous, and will eventually lead to remarkable results in obtaining a better standard for gear users and gear manufacturers. The standardization of inspection was also extensively discussed and will eventually lead to uniform practice in regard to this matter, especially in regard to complaints by users of gears for claims which are in no way the fault of the gear manufacturer. A standard form of contract providing for all eventualities is also under consideration.

The technical papers which were presented at the Tuesday morning session of the association included: "Gear Steels," by Dr. J. Heber Parker, of the Carpenter Steel Co.; "Worms and Worm Wheels," by G. W. Carlson, of the Timken-Detroit Axle Co., and "Proper Sizes and Materials for Gears for Tractor Construction," by E. J. Frost, of the Frost Gear and Forge Co. The papers were all very interesting and led to lengthy discussions.

In order not to interfere with the full attendance of the members at the convention meeting, no shop-visitation trips were planned during the course of the convention, but a great many invitations were extended to the members to visit plants of the different machine-tool and machinery manufacturers of Cleveland on the day following the close of the convention.

The following officers were reëlected to serve for another term: President, F. W. Sinram, of the Van Dorn & Dutton Co., Cleveland, Ohio; vice president, H. E. Eberhardt, of the Newark Gear-Cutting Machine Co., Newark, N. J.; secretary-treasurer, Frank D. Hamlin, of the Earle Gear and Machine Co., Philadelphia, Penn. The three vacancies on the executive committee were filled by the election of E. J. Frost, of the Frost Gear and Forge Co., Jackson, Mich.; Wm. Ganschow, of the Wm. Ganschow Co., Chicago, Ill., and J. B. Foote, of Foote Bros. Gear and Machine Co., Chicago, Ill.

The semi-annual meeting of the association has been fixed for Boston, Mass., for the dates of Oct. 6, 7 and 8, 1919. The general committee reports, and especially that of the standardization committee, will not be given out until they have an opportunity to put these into more concrete form and refer them to the associations for full consideration before adoption.

F. W. SINRAM
President

H. E. EBERHARDT
Vice President

F. D. HAMLIN
Secretary-Treasurer

B. F. WATERMAN, Chairman
Standardization Committee

Government Gets New Plan for the Sale of Tools

Machine-Tool Builders Want Larger Commission, Claiming 7½ Per Cent. Offered by Present Plan Inadequate

At a conference held recently in Washington between the representatives of the National Supply and Machinery Dealers' Association and the officials of the office of director of sales of the War Department, a plan was drawn up by a committee of the machine-tool dealers for the disposal of second-hand tools owned by the Government. It is understood the plan will soon be submitted to Government officials as a substitute for the Government proposal, which the dealers regard as unacceptable because the compensation offered is only 7½ per cent. Under the plan to be proposed by the dealers, the Government is asked to pay a total of 15 per cent.

While the machine-tool dealers assert they are not making any attempt to dictate to the Government what it shall pay, it is stated unofficially by some of the dealers that nothing less than a 15-per cent. commission will be accepted. The plan is to divide the country into 25 selling districts, these districts to be generally recognized by machine-tool builders in their selling arrangements with dealers. A dealer would be appointed in each district to be solely responsible to the War Department for all sales in his district, his compensation to be 2½ per cent. on gross sales. He is to have the right to enlist the coöperation of other dealers in his district, the idea being to sell various makes of tools through the distributer who handles new tools of the same make. The commission to be paid to these other dealers, as proposed, is 12½ per cent. The Government is asked to furnish warehouse space free until the tools are disposed of.

The following committee is in charge of the arrangements: George H. Cherrington, president of the Brown & Zortman Machinery Co., Pittsburgh, chairman; W. J. Radcliffe, E. A. Kinsey Co., Cincinnati, and J. W. Wright, Colcord-Wright Machinery and Supply Co., St. Louis. A special committee on the disposal of Government tools consists of M. A. Sherritt, Sherritt & Stoer Co., Philadelphia; H. W. Strong, Strong, Carlisle & Hammond Co., Cleveland, and Thomas A. Fernley, secretary and treasurer of the National Supply and Machinery Dealers' Association, Philadelphia.

Disposal of all new tools, which were bought by the War Department and not used, is to be arranged, if possible, through the machine-tool builders, each builder being asked by the Government to take back and resell his own tools on a 7½ per cent. commission.

Some of the builders, however, object to the commission as inadequate, especially as they pay their distributers 10 per cent. or more on all sales.

Business Items

The Wetmore Reamer Co. is the new name of the Wetmore Mechanical Laboratory Co. of Milwaukee. The company has taken more floor space and enlarged its offices. P. H. Dorr, recently released from service, has been made secretary and sales manager.

The Aborn Steel Co., Inc., has arranged to have the Charles A. Dowd Sales Co. of San Francisco, Calif., as representative on the Pacific Coast.

The Foster Machine Co., Elkhart, Ind., has secured the rights and privileges of a patent issued to W. A. Barker for the manufacture and sale of the Barker wrenchless chuck. Mr. Barker the inventor and patentee of the wrenchless chuck is now associated with the Foster Machine Co., as manager of the chuck department. He was formerly with the Thomas Elevator Co., Chicago, Ill., as general superintendent.

The Bailey Meter Co. has removed its main office and works from Boston, Mass., to Cleveland, Ohio. The Boston office, with Mr. H. D. Fisher as manager, is retained to handle sales and engineering service work in New England district. For the present New York and Philadelphia districts will be covered from Boston and all other districts will be covered from Cleveland.

William K. Stamets of Pittsburgh, Penn., is opening a new office in Cleveland, Ohio, under the management of Wm. S. Dickson, formerly general manager of the Greaves Klusman Tool Co., Cincinnati, Ohio.

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Lathe Firms of Syracuse Consolidate

The Porter-Cable Machine Co., with a large, new plant, five stories high, at Nos. 1708-12 North Salina St., Syracuse, N. Y., has taken over the Mulliner-Enlund Tool Co., of No. 541 South Clinton St., it is announced by the officers of both concerns. This is a consolidation of the only two industries in Syracuse making lathes.

The plant of the Mulliner-Enlund company, manufacturing machinery and other equipment, will be moved to the Porter-Cable Machine works, and G. N. Enlund and R. H. Mulliner will join the enlarged company. Mr. Enlund has been president and Mr. Mulliner, treasurer of the former company.

As a result of the merger the working force of the Porter-Cable Machine Company will be practically doubled, 150 persons being employed there now, and the Mulliner-Enlund force amounts to 135 persons.

The officers of the Porter-Cable Machine Company are: President, Walter A. Ridings: vice presidents, George G. Porter and Robert Love; treasurer, Frank E. Cable; secretary, Stewart F. Hancock; superintendent, L. J. Schuyler; chief engineer, W. H. Hafermalz.

Sixth National Foreign-Trade Convention

A Number of Papers Were Presented on the Foreign-Trade Outlook, and Extracts Are Here Given

The Sixth National Foreign-Trade Convention was held Apr. 24, 25 and 26 at the Congress Hotel, Chicago. The convention had a very interesting program and extracts are given from the various papers which are of interest to our readers.

A speech by Edward Prizer, president of the Vacuum Oil Co., entitled "Export of Industrial Products," in which he pointed out the needs of foreign trade, was delivered at the first general session on Thursday, Apr. 24. In this speech he said: "We are now facing an industrial crisis unless we can largely and rapidly increase our exports of finished products; for in no other way can our great industrial capacity be utilized. The export of raw or semi-finished articles unquestionably adds to national wealth but gives little aid to industry. We must export cotton in fabrics and not in the bale; iron and steel in machinery and implements; leather in shoes and other finished articles; use our coal in our own factory boilers; and in every way multiply the overseas movement of products of hand and brain which our recognized manufacturing and inventive skill, unequaled by any other country in the world, so eminently fit us to produce."

In addressing the opening session, William Pigott, president of the Seattle Car and Foundry Co., said: "In my opinion there is very little difference between the basic fundamental principles necessary to the development of foreign trade and the methods commonly used in the successful development of our home business. The elaborate training for foreign trade is much discussed, but I believe in the final analysis the salesman with the lowest cost and better quality of goods, speaking good plain American English, and possessed of average American honesty, application, and intelligence, will in the end book more orders than the man who wastes his time and his company's money aping foreign habits, customs and peculiarities. Manufacturers, business men and salesmen of the United States must cut down to plain living and high thinking before we can expect to secure any great proportion of competitive foreign trade."

J. W. Hook, president of the Allied Machinery Co., of America, opened a plea for a definite foreign-trade policy based upon the allotment of a certain proportion of product to foreign trade and on the establishment of all-American sales agencies.

"Can American Fabricated Products Hold Foreign Markets?" was the title of a paper by William E. Peck, president of W. E. Peck & Co., Inc., and which was delivered at the group session of the convention on foreign-trade merchandising.

Trade Catalogs

P. C. GUNION has recently been appointed advertising manager of the industrial division of the General Motors Corp., New York City.

JOHN BOSSERT, formerly in the local sales department of the Hart-Parr Co., Charles City, Iowa, has been appointed manager of the branch office at Wichita, Kan.

AMOS E. CARLE has recently been appointed to the machinery sales office of the Cadillac Tool Co., Detroit, Mich.

J. R. ASPLEY has been appointed head of the salvage department of the Hart-Parr Co., Charles City, Iowa. This is a new department at the Hart-Parr works, having been established since the close of the war, to take care of the machinery and material no longer needed for war manufacturing.

N. CLAUSEN, formerly superintendent of the Gillespie Loading Co., Morgan, N. J., has taken a position as engineer with the Epping-Carpenter Pump Co., Pittsburgh, Penn.

LIEUT. L. K. GOSS, Ordnance Department, U. S. A., recently discharged, has become associated with the Manufacturers Equipment Co., Chicago, Ill., as assistant to the president. Previous to his enlistment, Mr. Goss was in the employ of the Warner & Swasey Co. as a western representative and manager.

CHARLES A. DOWD has been released from the Production and Inspection Division along the Atlantic Coast. For the last three months he has been in charge of 17 plants in northern New York, as gage inspector. Mr. Dowd returns to San Francisco to take up the business under the name of the Charles A. Dowd Sales Co., under which name he did business before the war. He will represent the following firms: The Napier Saw Works, J. T. Slocomb, Thomson Welding Co., C. Johannsen, Vixen File Co. (Heller line), Cox Brass Co. All of his employees have been in the service and are going back into the firm with him.

New Publications

The Turnover of Factory Labor.—By Sumner H. Slichter. Four hundred and sixty 5½ x 8-in. pages; bound in dark-red cloth boards. Published by D. Appleton & Co., New York. Price, $3.

In the average plant the annual terminations of employment by discharge, resignation, or other causes approximate the average number of workers employed. Such a turnover involves a huge expense, and in an era such as the present, when industrial and economic conditions have assumed abnormal aspects, an understanding of so important a phase of the labor problem as is embodied in the present volume becomes an invaluable asset to the business man and manufacturer. The author was special expert on labor turnover for the Federal Commission on Industrial Relations. The book is based on the results of his extensive investigations for the commission, supplemented by many private inquiries. It suggests and explains methods for reducing the turnover by the application of right principles in the employment and training of employees and the adoption of the proper attitude in the handling of men. The book is constructive in its criticism; informing and timely. The book is divided into four parts. In Part I, the chapter headings are: What Is Labor Turnover? The Size of the Turnover; The Effect of Different Factors upon the Size of the Turnover; The Effect of Different Factors upon the Turnover Rate; The Numerical Importance of Resignations, Layoffs, Discharges and Miscellaneous Causes of the Turnover. Part II is divided into: The Cost of the Turnover to the Employer, and the Cost of the Turnover to the Workman. Part III: Survey of the Causes of Turnover; Causes of the Turnover Pertaining to the Job; Causes of the Turnover Arising from Relations between the Men and the Management; Causes of the Turnover Pertaining to the Men, and the Turnover Due to More Attractive Opportunities Elsewhere. Part IV: Survey of What a Number of Establishments Have Accomplished in Reducing the Turnover; The Fundamental Prerequisites for Reducing the Turnover; Hiring; Breaking in the New Worker; The Handling of Men; The Supervisor of Labor. Index.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

An engineer in France wishes to secure an agency for the sale of machinery of various kinds, equipment for carrying on public works (road-making machinery, etc.), and products and machinery for use in the chemical industry. Correspondence should be in French. No. 28949.

A man in Sweden wishes to secure an agency for the sale of cheap structural iron and iron shipbuilding material. Payment against bill of lading. Correspondence may be in English. Reference. No. 28952.

A company in China desires to purchase woodworking machinery for pencil making, such as planing machine, grooving machine, polishing machine, and double cutting off machines. Catalogs with full descriptions and prices are requested. No. 29152.

A firm in this country with a branch in Italy, and also proposing to open offices in other European countries, desires to secure agencies for the sale of electrical railway equipment, metal goods, and other electrical supplies, and especially insulated wires, cables, rubber goods, and all the machinery and materials for their manufacture. No. 29153.

A firm in England desires to purchase and secure an agency for the sale of railway rolling stock, mild steel sections, railway rails, cast steel castings, light railway equipment, railway stores generally, asbestos millboard, asbestos roofing, railway sleepers, French and Belgian standard, pressed steel work, built-up girder work, bridge work of a standard pattern, steel structures for building, wheels and axles, and all requirements for railway rolling stock and permanent railway equipment. Terms, cash against documents. References. No. 29109.

A company in Algeria desires to purchase a complete outfit of lathes, drills, tools, etc., for automobile repair work, and automobiles, motor trucks and tires. Correspondence should be in French. Reference. No. 29136.

An American firm with established connections in Denmark is in the market for automobiles, both trucks and pleasure cars, motorcycles, automobile parts and accessories, marine engines, tractors, aëroplanes, pneumatic and solid tires and tubes, brake lining, and tools and machinery for automobile shops and garages. References. No. 29068.

A firm in Italy desires to secure exclusive agencies for the sale of special tools, small machine tools, technical articles for various industries, and novelties of any kind which will obtain a ready sale in that country. No. 28980.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago. C. E. Drayer, national secretary, 29 S. La Salle St., Chicago, Ill.

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Railway Association, Mechanical Section, will hold its convention and exhibition at Atlantic City, N. J., June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

The American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association. Annual convention will be held June 23, 24 and 25, 1919, at Marquette Hotel, St. Louis, Mo. The officers of the association are: President, W. J. Moffatt; first vice president, G. B. Hosford; second vice president, W. W. Nash; third vice president, T. E. Holderby; secretary-treasurer, Otto E. Schlinck, 485 West 5th St., Peru, Ind.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meetings at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary, W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

National Machine Tool Builders' Association. Spring convention to be held at Atlantic City, N. J., May 12 and 13 with headquarters at Hotel Traymore. C. Wood Walter, secretary, Cincinnati, Ohio. C. E. Hildreth, manager, Worcester, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On May 29 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers. Spring meeting to be held at Ottawa Beach, Mich., June 23-27, 1919. Secretary, Coker Clarkson, 29 West 39th St., New York City.

Southern Metal Trades Association will hold its annual convention at the St. Charles Hotel, New Orleans, La., on May 5 and 6. W. E. Dunn, Jr., Chandler Building, Atlanta, Ga., is the secretary.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.